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VIEWS, NEWS AND INTERVIEWS.

The Electric Springs Railway, of Warrensburg, Mo., the only important street railway system of that city, has been sold for scrap iron. The rolling stock and other property connected with the system were also disposed of at a great loss.

The fight for cheaper fares on street-railway lines has been removed from Chicago, Ill., to Springfield. Representative Nohe, of this city, has introduced a bill in the legislature which provides that all surface and elevated street railways in cities of over 200,000 population shall sell seven tickets for 25 cents and shall give transfers at all intersections of lines owned by them.

The recent article on the value of incandescent lamp filaments that appeared in the ELECTRICAL REVIEW is still attracting attention from the lamp manufacturers and lamp users. Some of them apparently had never appreciated this minute treasure. Refinement of this slender and as yet vital factor in lamp construction is the constant aim of the producers of incandescent lamps.

The earnings of the Central Union Telephone and Chicago Telephone companies, licensees of the American Bell Telephone Company, operating in Illinois, Indiana and Ohio, are compared below:

	Central Union, 1896.	Chicago, 1896.
Capital stock	$6,605,300	$4,336,500
Bonds	1,600,000	.....
Gross earnings	1,327,931	1,055,829
Net	301,820	600,204
Interest	64,521	.....
Dividends	66,053	499,224
Surplus	171,046	100,980
Earned on stock	3.5	13.84

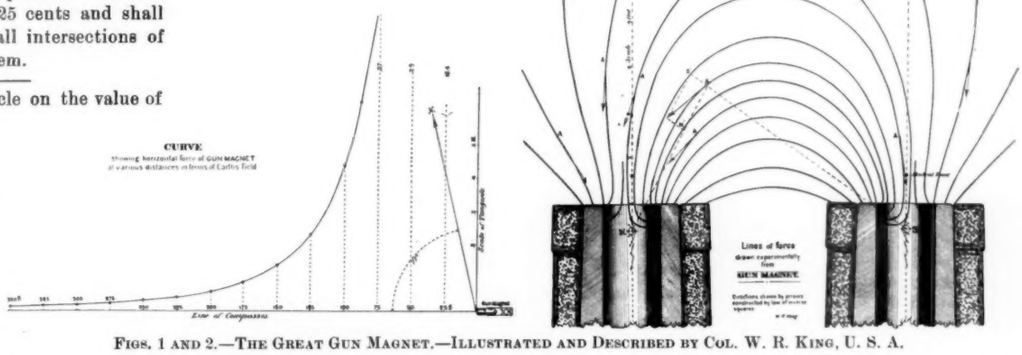
In the case of the Chicago Telephone Company, net earnings were the largest in the history of the company, showing a gain of $75,365, but in the case of the Central Union the effect of competition has been apparent, net earnings falling off nearly $125,000.

A Proposed Experiment to Demonstrate that X Rays Are Material.

In line with the theories advanced by Tesla, that Roentgen rays are particles of matter, Mr. T. B. Kinraid, whose researches and experiments relative to fluorescent salts have been of general interest to the scientific world, outlines a proposed test by which he demonstrates Tesla's theory. In an interview with a representative of this journal, Mr. Kinraid said: "I want to take several methods, when I can make sure that I have the necessary time, to develop the following experiments, which I believe will show conclusively the nature of the unknown rays."

The test as outlined by Mr. Kinraid is substantially as follows: Two metal disks, one and one-half inch in diameter, are to be made of a metal that is sonorous, but has the power to intercept the X rays. These disks are to be accurately and perfectly gauged, so that there shall be no chance for variation in their condition during the life of the experiment by being subjected to a long period of graduation. Each of these disks is to be supported on its center by a small stem which will permit it to have perfectly free vibration, and mounted on these disks are to be very delicate hammers, so that these hammers may start the vibration of the disks. The resonators are then to be connected by a tube, and from that tube a second tube will be connected, so that it can be taken to the ear. A difference in the vibration frequency must be arranged for, so that that difference can be reckoned per second. One of the disks and its resonator will be inclosed in a thick metallic case, not allowing any of the rays to pass through, and the other disk to be subjected to the vocalized energy of a powerful Crookes tube, so as to concentrate on it all the energy possible.

Mr. Kinraid believes that if the X rays have any of the qualities of matter as we know it, it will produce a certain phenomena in the metallic plate, and if it is physical matter it will increase the vibration of the disk exposed to the rays and also the frequency of the other disk. This variation will be instantly detected by the ear at the tube, and the variation of the frequency of the two disks may be recorded.



FIGS. 1 AND 2.—THE GREAT GUN MAGNET.—ILLUSTRATED AND DESCRIBED BY COL. W. R. KING, U. S. A.

Not the Ottawa, Ontario, Electric Railway.

Relative to a note published in this journal as to the reorganization of the Ottawa Electric Railway, we have the following from Messrs. Ahearn & Soper, contracting electrical engineers, of Ottawa, Ontario:

"We presume that this refers to some town called Ottawa in the western States, as there are several places of this name. We shall be pleased if you will make the necessary correction, as the Ottawa, Can., Electric Railway Company is not the road in question."

The Ottawa referred to is in Illinois.

THE GREAT GUN MAGNET.

SOME MEASUREMENTS OF THE MAGNETIC STRENGTH MADE BY COLONEL KING, LIEUTENANT-COLONEL ENGINEERS, U. S. A.

TO THE EDITOR OF ELECTRICAL REVIEW:

Referring to the article on my "Gun Magnet," in your issue of February 27, 1895, and the remark therein that some further experiments might be made, I now take pleasure in forwarding the following brief account of some measurements of the strength of the magnetic field at different distances from the magnet. These experiments were made in June, 1895, but the results have not been worked up until quite recently.

For the purposes of these tests the electro-magnet—which, it will be remembered, was made by wrapping about 10 miles of insulated wire around a 15-inch cast-iron cannon weighing 50,000 pounds—was placed as nearly east and west as practicable, and small compasses with about two and one-half-inch needles were located at intervals of 25 feet in the prolongation of its axis, as shown in Fig. 1. Owing to unavoidable obstructions, the line of compasses made an angle of 77 degrees with the magnetic meridian instead of 90 degrees, and the necessary correction was made in the formulas.

After the compasses had all been set as nearly as possible with zeros in the magnetic meridian, the current was turned on the magnet and gradually increased to a maximum steady current of about 25.8 amperes, when all of the compasses were read simultaneously. The current was then reversed, and the readings were again taken; these operations being repeated several hours later, so as to get reliable mean readings.

Had the axis of the magnet been due east and west, the strength of field would have been given by the formula $P = H \tan. D$, in which H is the horizontal component of the earth's field, and D is the observed deflection; but as it made an angle of about 77 degress instead of 90 degrees with the magnetic meridian, the following formulas were used, viz.:

For deflections east:

$$P = \frac{H \sin D}{103^\circ - \sin D};$$

and for west deflections:

$$P = \frac{H \sin D}{77^\circ - \sin D}.$$

The results thus reduced were tabulated as follows, the figures given representing the strength of the field in terms of the earth's field, or, in other words, the numbers by which H should be multiplied to give the horizontal strength of field due to the magnet:

Station.	Distance.	A. M.		P. M.		Mean.	Computed
		East.	West.	East.	West.		
1	25	16.15	16.85	14.1	18.4	16.375	16.4
2	50	2.519	3.410	3.418	2.075	2.855	2.9
3	75	.882	1.021	1.014	1.021	.984	.97
4	100	.379	.432	.433	.415	.415	.438
5	125	.259	.230	.250	.219	.239	.234
6	150	.131	.148	.140	.125	.136	.139
7	175	.071	.073	.087	.104	.084	.089
8	200	.062	.054	.079	.082	.069	.061
9	225	.0448	.0315	.053	.0458	.0438	.043
10	250	.024	.024	.038	.044	.0325	.032
11	275	.....	.....	.....	.....	.....	.024
12	300	.....	.....	.....	.....	.....	.019
13	325	.014	.014	.....	.020	.0160	.015
14	350	.....	.013	.013	.013	.0130	.012

The figures given in columns three to six are the values computed from the observations, while those in the last column are computed from an empyrical formula. The close agreement of these last values with the average values given in the seventh column is remarkable, considering that no very great accuracy was attempted in the observations. It will be noticed that at a distance of about 74 feet from the gun the value of P was unity, or the strength of the field was equal to the horizontal component of the earth's field. The first formula used had the origin of co-ordinates at the muzzle of the gun, and involved both the square and cube of the distance. By transferring the origin to a point seven feet in rear of the muzzle (which is supposed to be about midway between the poles of the magnet), the formula was very much simplified, and reduced to $P = \frac{537060}{X3}$, which corresponds with theory; viz., that the field of a magnet diminishes in strength as the cube of the distance from the center of the magnet increases.

These experiments have furnished a very conclusive proof of the theory on which the magnetic lines of force are determined. In one of the experiments two 15-inch guns, each wound with four miles of wire, were placed side by side and yoked together by a pile of railway bars, making a large horseshoe magnet, and a wide drawing-board was placed horizontally in front of the guns, with a sheet of paper upon it, and on this the lines of force were traced, as shown in Fig. 2. In tracing these lines a piece of small iron wire, about three inches long, was used as a needle and was moved along step by step, the rear end being placed where the front end was, at the preceding step. The wire was moved by a small thread attached to its middle point, so that it was free to take up the direction of the lines of force.

On the same sheet the direction of the lines of force, at a number of points, has been laid down by geometrical construction, as follows: Assuming any point as at A, Fig. 2, lines were drawn to the poles of the magnet as near as they could be located at N and S, and on these lines are laid off the distances A N^1 and A S^1, the lengths of these lines being made inversely proportional to the squares of the distances A N^1 and A S^1, or, in other words, proportional to the force exerted at A by each of the poles. The diagonal of the parallelogram, thus constructed, indicates the direction of the lines of force at the point A, and the tangency of the lines so constructed (and shown by arrows), with the curves traced experimentally, shows a close agreement between theory and practice.

The neutral point, which was found about seven inches in front of the magnet, may be explained as follows: If a thin section be cut from the gun through its axis it will be seen that the two pieces cut from the walls of the gun will make two like poles of a magnet near each other. Up to a certain point they will, therefore, repeal any magnetic substance placed between them; but beyond that point they will attract it, and the point itself must, therefore, be neutral. This is evident from the directions of the lines of force, which at first converge towards the axis of the gun in their effort to get away from each other after leaving the metal, but soon diverge when they get far enough away from the opposing similar magnet formed by the opposite side of the gun. The same state of things exists whatever the direction of the section; or, in other words, the neutral location is a point—not a line or surface—and it is evident that this point is enveloped by equi-potential surfaces that might be located by drawing curves cutting the lines of force at right angles.

The question has been asked: "Is the field produced by this magnet stronger than that of other magnets per square inch, or is its great power due to the fact that the field is larger, being produced by a much larger mass of metal?" Some light is thrown on this subject by the experiment made to test the sustaining power of the magnet. The armature, which consisted of six plates of wrought-iron in a pile six and one-quarter by 21 inches in cross-section, had a contact of 56¼ square inches with the muzzle of the gun. The pull required to separate the end of the armature from the gun was 22,400 pounds, or about 400 pounds per square inch of contact. The entire pull on the armature was 44,800 pounds.

In the experiment (shown in Fig. 3, in the ELECTRICAL REVIEW of February 21, 1895), where five 320-pound projectiles were suspended from the muzzle of the gun, the tension between the first projectile and the gun must have been 1,600 pounds, while the area of contact was theoretically only a point.

It is not known just how much of the weight was sustained by the lines of force passing through the point of contact, nor how much was carried by the lines passing through the air around that point; but from the well known fact that the sustaining power of a magnet diminishes at a very rapid rate when the armature is separated even by the smallest fraction of an inch, it is more than likely that the metal immediately around the point of contact sustained from 800 to 1,000 pounds per square inch. For example, an electric magnet that would sustain 220 pounds, dropped to 90 pounds when the armature was separated from it only $\frac{1}{250}$ of an inch. It is evident, therefore, that with a sphere 15 inches in diameter touching a cylinder 25 inches in diameter, the metal even half an inch from the point of contact would sustain but a mere fraction per square inch of that at the point of contact. A few years ago Prof. Rowland expressed the opinion that 175 pounds per square inch was about the maximum attainable with an electro-magnet. Joule attained 200 pounds, and Bidwell increased it up to 226 pounds. By a special method of concentrating the force on a very small area, Ewing is said to have greatly increased these figures.

To compute the number of lines per square inch, the formula for sustaining power of electro-magnets may be expressed as follows:

$2 \text{ Log } B = \text{Log } P - \text{Log } A + 7.85875.$

B = number of lines of force per square inch.
P = pull sustained by magnet in pounds = 22,400 lbs.
A = area of contact = 56¼ square inches.

Log P = 4.35024
Log constant = 7.85875
12.20899
Log A = 1.75011
2)10.45888
5.22944 170,000 = B.

To calculate the reluctance of the magnetic circuit we have the formula:

$$B = \frac{M}{Z}, \text{ or } Z = \frac{M}{B}$$

in which Z = reluctance.
M = magneto-motive force.
B = number lines of force in circuit.

Log Z = Log M − Log B,
but M = number ampere turns × 3.192 = 432.256,
and B = 170,000 × 56¼ = 9,562,500.
Log M = 5.63583
Log B = 6.98059
−2.65524 .0452 = Z.

No attempt has been made to calculate the magnetic leakage, which, from the form of the magnet, must have been very great. This factor, as well as the reluctance, was doubtless also increased by the number and roughness of pieces forming the magnetic circuit.

Since the application of X rays to photography, several persons have suggested the possibility of using magnetic rays (as illustrated in Fig. 2 in my first article, showing attraction through a soldier's body) for the same purpose. Three serious difficulties would have to be overcome before this could be accomplished; viz., the tendency of the lines to curve away from each other; the difficulty of intercepting these rays, or even of refracting them except by the use of some magnetic substance, and finally of getting a sensitive plate that would be acted on by magnetic force.

The first of these difficulties might possibly be overcome, at least partially, by using concave magnet poles facing each other, while the third could possibly be met by using some solution carrying minute particles of iron, magnetic oxide, or some other magnetic substance. The second difficulty appears to be insurmountable, although in these days it would hardly be safe to say that it is absolutely so. W. R. KING.

Rock Island, Ill., January 18.

Calendars for 1897.

An artistic, prettily colored and neat calendar comes to us from Wyckoff, Seamans & Benedict, the sole manufacturers of the great Remington typewriter.

The Electric Appliance Company, of Chicago, send us a calendar that has "four of a kind" that is hard to beat. Each is an ace, named "O. K." wire, Armorite conduit, Electric Appliance trade mark and Paranite wires and cables. This heading is a very happy one. Seasonable goods are announced on the pages devoted to the different months.

The James Kempster Printing Company, of New York, has favored the ELECTRICAL REVIEW with a calendar, as neat and serviceable as any that have come to this office. This great printing house kindly remembers its friends in this way annually, and this calendar, we notice, is the one always kept on desks for daily use by all recipients.

The Peckham Truck Company compliments the REVIEW office with a magnificent calendar—one of a size that pleases near-sighted editors. It is illustrated in a seasonable and suggestive way, showing street-railway snow-plows for the Winter months and open cars and commodious palace cars for the Summer season. An occasional candid mention of the good qualities of the Peckham truck is very properly given.

Committees of the Northwestern Electrical Association.

The following committees to serve for the ensuing year were appointed by the chairman before the adjournment of the Northwestern Electrical Association, recently convened at Milwaukee:

Protective committee: Mr. Norcross, of Janesville; Mr. Copeland, of La Crosse; Mr. Mullein, of Milwaukee.

Programme committee: Mr. Mercein, of Milwaukee; Mr. Deland, of Chicago; Mr. Korst, of Racine.

Special committee: Mr. Collins, of Elkhart; Mr. Coleman, of Fond du Lac; Mr. Page, of Oshkosh.

Insurance committee: Mr. Lord, of Waupaca; Mr. Debell and Mr. Merrill, of Ashland.

Entertainment committee: Mr. Copeland, of La Crosse; Mr. Hanley, of Marinette; Mr. Daniel, of Menominee.

Ways and Means committee: Mr. Pamperin, of Oconto; Mr. Grimme, of Jefferson; Mr. Davis, of Neenah.

X RAYS, APPARATUS AND METHODS.

ABSTRACT OF PAPER READ BEFORE THE ELECTRICAL SECTION OF THE FRANKLIN INSTITUTE, PHILADELPHIA, DECEMBER 1, 1896, BY ELMER G. WILLYOUNG AND H. LYMAN SAYEN.

(*Continued from page 45.*)

TESLA COIL OR INDUCTION COIL—WHICH?

Having carefully examined the results, apparatus and methods of others all over the country, devotees some of the "high-frequency" coil, some of the induction coil, and having made many and careful experiments with both forms of apparatus ourselves, we favor the induction coil. Our reasons for this preference are briefly stated:

A. Simplicity: One coil instead of two.

B. Ease of Manipulation: There being more than double the number of factors to attend to in the Tesla coil than in the induction coil.

C. Cleanliness: The "high-frequency" coil requires an oil bath, which must be renewed from time to time to avoid gumming. It is difficult, also, to find an oil which will not, eventually, act upon the insulation of the wire by virtue of the acid or other impurities which the former may contain.

D. Sharp Definition: The "high-frequency" coil produces an alternating discharge — thus with the double-focus tube giving us two sources of X radiation and consequent blurring of the image. If a single-focus tube be used, the discharge in one direction is either lost or tears off particles of the platinum reflector, thus blackening the tube and soon destroying its effectiveness.

E. Noiselessness: This, from the surgeons' and physicians' standpoint, is perhaps the most important consideration. With tube in action the induction coil is practically noiseless, save for the low hum of motor or vibrator. Improperly designed vibrators often rattle and rasp in a very irritating manner. In the "high-frequency" coil, however, the disruptive discharge over the air gap is the vital cause of its action. It is much more violent than a discharge of corresponding length from the induction coil, being of a rattling, cracking character. That such noise can not but have a most unpleasant effect upon the patient who comes into the operating-room in a condition of more or less nervous collapse anyway is obvious.

F. Strain on Tube: It has been argued by advocates of the "high-frequency" coil that it is much less hard upon the tubes. Our own observation has been just the reverse of this and has satisfied us that the wear and tear is very much less with the induction coil.

G. Results: Although we have diligently examined, we have yet to see results obtained by any form of apparatus superior to those made right here in Philadelphia by Dr. Goodspeed, of the University of Pennsylvania; Dr. Stern, of the Polyclinic Hospital; ourselves, and many others who might be mentioned, and this either as regards detail, penetration or quickness of exposure. Indeed, we may say that we have never seen results obtained with the Tesla coil that are equal in any of the above respects to the results just referred to.

THE TUBE.

Many forms of tubes have been suggested. With practically no exception, all tubes now in use employ as cathode a concave aluminum disk, whose center of curvature is at the center of a small platinum plate (three-eighths to three-quarters square inch in area), the plane of the plate being inclined to the normal from center of the concave cathode. This platinum plate is sometimes made the anode — sometimes the anode is a separate plate or wire elsewhere in the tube. This form of tube is known as the "focus" tube, the cathode rays being focused upon the platinum plate, which then becomes the active source of X rays. In the double-focus tube we have two concave cathodes at opposite ends of the tube, the platinum wire reflector being in the form of a wedge with a side presented to each of the concave cathodes.

In the use of the tube everything depends upon the vacuum, X rays seeming to be of a heterogenous character just as are light rays, the quality of the X ray varying with the degree of vacuum. The higher the vacuum, the more penetrating power the tube has. Hence it is well to select tubes and use different tubes for different purposes. A tube of extremely high exhaustion is best for working through the body, but with forearm, hands, feet, etc., the tube has too great penetration, the bones appearing almost equally transparent with the flesh.

The chief difficulty with most tubes is the change of vacuum which takes place in use. This is thought to be due to the occlusion of the residual gas upon the inner surface of the glass—resulting in an increased vacuum. It may be partially restored by heating the tube by use of a spirit lamp or Bunden flame. This must be very carefully done, however, to avoid cracking the tube. When the platinum reflector is used simply as an anti-cathode, and the anode is aluminum, a simple reversal of the discharge will prove fairly successful. Some makers have adopted the scheme, practiced now for many years, of blowing a small side pocket upon the tube, into which is placed phosphoric anhydride or some other chemical substance or composition absorbing moisture. When heated, this substance gives off vapor to make up for the loss. It is difficult, however, to drive off just the right amount of vapor in this way, and the vacuum is liable to be made too low, in which case flesh and bone are about equally opaque. So rapid is this change of vacuum, that in most cases involving over a few minutes' exposure or running of the tube, one of the above methods becomes necessary. In any case, eventual almost complete exhaustion seems to be the rule, and the tube must then be returned to the makers and re-exhausted.

"Blackening" is another cause of decreased efficiency in the tube. It is due to deposition of platinum upon the inner surface of the tube.

The "Bowdoin" tube, shown in Fig. 5, was devised after a considerable amount of experimental work by Professors Robinson and Hutchins, of Bowdoin College. In general design it does not differ essentially from many other forms of focus tube upon the market. The two respects in which the tube does differ from other tubes are: 1st. In the arrangement of electrodes the reflector plate is not connected to the coil at all, but merely acting as an obstacle to the bombarding rays, while the anode is a disk at the end of the tube away from the cathode. This arrangement is found to perfectly and entirely prevent blackening, no matter how long the tube may be used.

The most important feature of this tube is, however, the presence upon its interior surface of a fluorescent material which has been fused right into the surface of the glass. As the tube is used, this material, either by the bombardment, or heating, or both, gives off just enough air or vapor to make up for the occlusion due to the natural working of the tube. The vacuum, therefore, tends to remain always constant. Although it seems almost absurd that one could put in just enough of this material to make up for the gas otherwise lost, yet it is a fact that these tubes remain practically unchanged in vacuum at all times, the equivalent spark length retaining its value at all times within, at the outside, a variation of 10 per cent.

In use the tube requires no "nursing" whatever. It should always have to start with a parallel spark gap which should be quite small, say an inch or an inch and one-half, and either the primary current or the vibrator tension adjusted so as to produce only very small secondary discharge. The energy of this secondary discharge may then be immediately increased until the reflector plate shows a dull red spot of about half the size of the nail of the little finger. The tube is now in its most efficient condition, and, with a well constructed and smooth-working brake, may be run for an hour or two without the slightest attention. The "getting ready," as above described, takes considerably less time than the time it has taken us to describe it. Indeed, in our own work, we do not trouble to make this preliminary adjustment at all, as we make it once for all when we first begin to work with a tube, and do not afterward disturb it, merely closing down the switch when starting work.

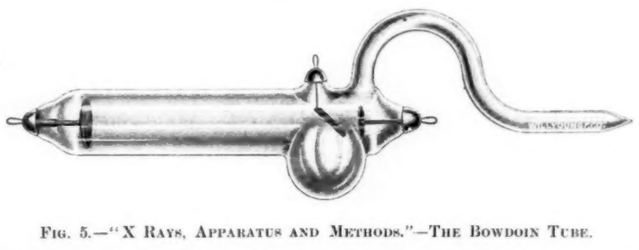


FIG. 5.—"X RAYS, APPARATUS AND METHODS."—THE BOWDOIN TUBE.

[To be concluded.]

The Metropolitan Street Railway Company Indicted.

The Grand Jury of New York indicted the Metropolitan Traction Company and the Metropolitan Street Railway Company, last week, for maintaining a public nuisance. The public nuisance is the propelling of cars at high speed on the Broadway cable curve at Fourteenth street, known to the press of the city as "Dead Man's Curve."

The charge under the indictment is a misdemeanor, and the corporations, if convicted, can be fined $500. But in case it is shown later that the officials of the corporations give orders to continue the nuisance, they may be individually indicted and arrested. The attorney of the railway company will appear in the Court of General Sessions this week to plead to the indictment.

TELEPHONE NEWS AND COMMENT.

The annual report of the Central New York Telephone and Telegraph Company, of Utica, N. Y., shows the following: Capital stock, $800,000, of which $500,000 is actually issued; debts, $70,000; assets, $100,000.

The Bradshaw block, in Waxahachie, Tex., including the Bell Telephone central office and a number of stores, saloons, restaurants and a newspaper office, have been destroyed by fire, causing a total loss of $65,000. It is not known how the fire originated.

At the annual meeting of the stockholders of the Orange County Telephone Company, the following board of directors for the ensuing year were elected: T. D. Mills, J. E. Iceman, R. C. Tuthill, Jr., Leander Brink, L. V. Sinsabaugh, G. A. Swalm, Jr., J. L. Wiggins, A. B. Wilbur, T. A. Weller, Frank Harding, L. S. Stivers, Wm. A. Marshall.

At the regular annual meeting of the stockholders of the Home Telephone Company, of Wabash, Ind., the following officers were re-elected: R. F. Blount, president; F. M. Lake, vice-president; J. M. Haas, secretary, and John Hipskind, treasurer, while the following board were elected to serve the ensuing year: R. F. Blount, F. M. Lake, John Hipskind, J. M. Haas, Thos. McNamee, Jr., Alf. Harter and W. S. Stitt.

The Johnstown, Pa., Telephone Company has an all-night service at its central office, and has established in connection therewith a unique method of helping out those of its subscribers who do not care to trust themselves to get up at a certain desired hour without some outside assistance. It is a call system, something on the style of that in vogue at the hotels. The subscriber who wishes to wake at a certain hour calls up central and tells the operator, who "makes a note of it." When the set hour arrives the operator rings up the subscriber who made the request. If he turns over and fondly imagines it's only an alarm-clock, he's nicely fooled, says a local paper, as the telephone bell will keep ringing until an answer is turned in to central, giving assurance that the sleeper is awake. In the same manner, if a physician is called for and can not be reached, if requested, he will be notified of the call as soon as he can be reached and told whence it came.

A Large Armorite Contract.

Mr. James F. Cummings, general manager of the Armorite Interior Conduit Company, of Detroit, has just closed a large contract for his company's popular Armorite interior conduit. The contract calls for 200,000 feet of conduit, to be used in the new Girard Building, at Twelfth and Girard streets, Philadelphia. The day the contract was closed Mr. Cummings telegraphed the order to Detroit, and 35,000 feet of Armorite were shipped to Philadelphia at once. Armorite is rapidly making an enviable reputation for itself, especially in the East, where Mr. Cummings's effective and progressive methods are rapidly bearing fruit.

THE EQUIPMENT OF MANUFACTURING ESTABLISHMENTS WITH ELECTRIC MOTORS AND ELECTRIC POWER DISTRIBUTION.

READ BEFORE THE WESTERN SOCIETY OF ENGINEERS, DECEMBER 9, 1896, BY PROF. DUGALD C. JACKSON.

(*Continued from page 35.*)

8. *Cleanliness* — This point has been sufficiently touched upon just before.

The experience in all the establishments, from which I have been fortunate enough to receive information, shows that for plants using not less than 100 horse-power the electrical transmission is so much more satisfactory and economical that it is a misfortune for a new manufacturing plant, except under very exceptional conditions, to be constructed with any type of transmission except the electric. It is to be understood that the electric equipment should be such that crane motors can be operated from the generators and transmission wires which are laid down for the regular factory power distribution, and, for the best results, the generators should also be adapted to the purpose of factory lighting. These conditions are fulfilled by either a 220-volt continuous-current system, using compound wound generators, or by a polyphase alternating-current system. In the average manufacturing establishment the former seems to promise the best results, though more experience with the latter may prove it to give equally satisfactory results. The 220-volt continuous-current plant allows the use of 220-volt incandescent lamps connected directly between the positive and negative transmission wires, or arc lamps may be used in sets of four.

The status of electrical transmission in plants already built and equipped with mechanical transmission is more complex. Establishments which turn out heavy products, such as locomotive works, engine works, boiler works, machine tool works, iron mills, etc., profit so much by electrical cranes that an electric plant is an invaluable accessory. It is then a natural step to do away with counter shafts and belts running to the larger tools, which may then be equipped for driving by electric motors and placed in a more convenient position with reference to handling the product. This change always results in a large reduction of the cost of manufacturing, and if carried out with caution and judgment is invariably satisfactory. A somewhat similar condition exists in establishments which turn out a bulky product, such as agricultural works, carriage works, etc. The convenient arrangement of machinery which may be gained by using electric motors adds materially to the product that can be put through such a shop, or largely reduces the transmission losses caused by quarter-turn belts, bevel gearing, etc. In the case of a plant of this type, upon which careful and complete tests have lately been made by two of my students, it is shown that the actual saving of power, attendance and repairs, now lost in great quarter-turn belts and other features usual in the mechanical transmission system of a somewhat scattered agricultural works, would nearly pay the annual sum necessary to cause a change of the old system into an electrical system to be profitable; while additional convenience in the location of tools, immunity from expensive stoppages due to injured belts, etc., and the advantages of satisfactory illumination gained from the power generator would give a large margin of profit upon the expense of putting in the electrical plant. Establishments which turn out a lighter and less bulky product gain less in convenience from the electric power, but there are numerous industries in which the cleanliness resulting from the suppression of shafts and belts is of the greatest moment. In these the electrical transmission may be made a great money saver, as is shown by the experience of its users.

There are many special conditions which make the adoption of electrical transmission of advantage in established industries, where otherwise it would not pay to incur the expense involved in a change from an established mechanical transmission to a new electrical transmission. Thus, for instance, when an isolated building is located at some distance from the main building of the plant, the expense of operating a separate steam plant in that building, or of conveying power to the building by piping steam from the main plant, or by means of mechanical transmission, is often several times as great as the total annual cost of a complete electrical plant to be used for the purpose. In the total annual cost I include interest and depreciation, as well as fuel, attendance and repairs. A number of cases of this kind have fallen under my observation.

Another case, in which the same result obtains, came under my observation recently. Here the establishment was a large one, with considerable transmission losses (equal to nearly 70 per cent of the average useful load), and a considerable economy in fuel, attendance and repairs would be effected by replacing the mechanical by an electrical transmission. The large expense involved justly deterred the proprietors of the plant from entering upon the change. The prime power plant of the establishment is now found to be too small to carry the maximum load of the plant with late additions, while the reduced percentage of loss incident in this case to the electrical transmission would enable the engines to carry the load satisfactorily. The complete cost of a change to the electrical transmission is not greatly in excess of the cost which would be required in making the changes in the power plant, which would be required for the purpose of adding an engine. These conditions being fully considered, and charging the excess cost only to the electrical transmission, the latter would make an annual saving in the cost of operating the works which would well repay for its installation. The electrical plant is here placed upon a basis which is quite near its position with respect to new establishments.

It is unnecessary to multiply similar instances, but I will close by summarizing the matter as follows:

1. In constructing new manufacturing plants, the extra first cost of a complete system of electrical transmission for the works is negligibly small (except under exceptionable circumstances) compared with the annual saving effected by its means when its advantages are properly utilized.

2. In certain industries the advantages of electrical transmission outweigh the first cost of making a change from mechanical to electrical transmission in established plants, while in many plants where this condition would not commonly exist the arrangement of buildings or the growth of the plant is frequently of a character, with reference to the prime power plant, which places electrical transmission upon an advantageous footing, either as an auxiliary to the main transmission or as a rival to the existing mechanical transmission.

There is one more important question which affects electrical transmission alone. That is the question of the subdivision of power at the machinery. Briefly, the following seems to be the general consensus of opinion amongst those who have operated plants with electrical power: All large tools, such as use from five to seven and one-half horse-power and over, should be supplied with individual motors, while smaller tools or machines requiring less power should be grouped and driven from motor-driven shafts. These groups should ordinarily be arranged so that a motor of not less than from three to five horse-power capacity is required, and not more than from 10 to 15 horse-power. The grouping of tools and subdivision of the power, it may here be said, is a matter which can be given only the most general treatment as a whole, as each industry includes conditions of its own which must be taken into the count.

It may be pertinent to remark at this point that I have excluded from consideration all data obtained from electrical transmission plants in the manufacturing establishments of the electrical companies. There are a half-dozen such plants, several of which are very large, from which excellent results have been obtained, but these must lie under the suspicion of being "show plants." I therefore have confined myself to the results obtained in plants which are entirely independent of the electrical industries.

DISCUSSION.

Mr. Nichol: I would like to ask Mr. Jackson if any of these plants that he has taken have used the electric tool; for instance, the lathe—where it gets into the extreme refinement? I think he has touched on that in general. I would like to know if that is included in the plant?

Mr. Jackson: A great many tools are directly driven through gears or belts, but only in a very few cases are the motor armatures mounted directly on the spindles of the tools.

The Chair: There is a use of electric power in a small way from the manufacturing plant, I believe, driving isolated printing plants and machines of various kinds, in which the electric power is not derived by the owner or operator of the machines, but possibly from some of the general electric companies. I believe that Mr. Jackson did not cover the merits of that class of machinery in this paper.

Mr. Jackson: In case of printing establishments, the question of cleanliness is so important that in many large establishments they may save thousands of dollars per year by suppressing their belts and shafting, and in such cases they can well afford to equip their larger presses with direct-connected electric motors, while the smaller machines can be equipped in groups. This is being done in a great many cases in the East. I do not think of any printing establishment at present in Chicago where it is carried out, but there are many cases in Boston, New York, and perhaps Philadelphia, where it is done. In some printing establishments that I have seen, the establishments own their own steam plants and generate their own current; in other cases they buy the current from the local illuminating companies. It depends upon circumstances whether purchasing from outside concerns is cheaper than the generation of the current in the building. In large cities the generation of from 50 to 250 horse-power in a building is a somewhat expensive performance, and it is very frequently that the current is purchased. I believe there are comparatively few that have 250 horse-power to buy. The printing establishments have found, as far as I can find out, that electricity is a paying investment, on account of its cleanliness, if for no other reason.

Mr. Coster: I would like to take one little exception to the very admirable paper of Professor Jackson. He made a statement that the polyphase motor would, in a short time, come up to the direct motor, or something to that effect. Will you kindly read the exact remark?

Mr. Jackson: I will read the exact remark. [Reads.] "In the average manufacturing establishment the former (that is, the 220-volt continuous current system) seems to promise best results, though more experience with the latter (that is, the polyphase system) may prove it to give equally satisfactory results." In explanation of this statement I may say that it is an unfortunate fact that I was able to get data from only one establishment, outside of the electrical manufacturing establishments, which was equipped with polyphase motors. The statement came to me from this establishment that the fuel expense is greater now than it was formerly with mechanical transmission (shafts and belts). Experience with polyphase transmissions in manufacturing establishments is so limited that one is forced to the position held in this paper, which position is certainly entirely fair to the polyphase system.

Mr. Coster: I am very glad you are so fair. I will tell you why it costs more to operate this particular plant. These people put in an experimental plant to test the reliability of electric power; they work it in connection with their steam plant; they have not put in sufficient power to enable them to shut down the other steam engines. I saw the vice-president of the company, and he told me he would have enlarged his plant considerably this year if it had not been for the financial condition of the country and the uncertainty before the Presidential election; also that he surely expects to extend very largely next Spring. I would like to enlighten Professor Jackson in a few very brief remarks, and tell him some of the decided advantages of the polyphase system over the direct-current system. First of all, the motor has no brushes, commutator or collector of any kind; this is the very last type of motor which the Boston & Maine Railroad are installing in their new shops at Concord, N. H. Secondly, you can obtain a motor which is much more efficient at less than full load than any direct-current motor that is manufactured. Third, you have a system which, owing to its flexibility, has practically no limit to the distance of transmission within 15 or 20 miles. There are many more, but I do not wish to take up your time at present. These are some of the principal advantages, and it is plain that they are very important ones.

The Chair: We would like to hear further on the subject, either from Mr. Coster or from any other gentleman present that can discuss the matter. Mr. Arnold, could you say anything on that subject?

Mr. Arnold: I can not say that I am quite so sanguine about the polyphase motor for this particular application of the work. I do think it has a very large field, where the motor load is practically constant, or where it is not necessary to start it and stop it too often. I won't say

that it might not be for such cases as Professor Jackson has mentioned, but I have not had sufficient experience with it to know from my own judgment. I have put in a number of power transmission plants in factories for distributing power with direct current, and am getting good satisfaction with it. I am now installing in a printing establishment printing machine motors and printing presses. I also equipped a factory about a year ago, where I thought the conditions were very nicely created for the adoption of electric transmission by the burning of the old factory, which was built on the belted principle. We rebuilt the plant on electric lines, and he seems to be very much pleased with it.

I wish to take one exception to the statement Professor Jackson made, which he has since modified, so that it need not be considered a criticism, which is to the effect that it will pay you to buy power for small establishments. I believe he put the limit up to 250 horse-power. In any plant over 150 horse-power you can produce the energy, in my judgment, for less money than you can afford to buy it, because you almost invariably have to heat the building, and you must have a boiler plant. You have got to have an engineer to run the boiler plant, according to the city license, therefore you are saddled with the expense of an engineer, and probably a fireman. That being the case, you can operate an electric plant with little additional expense, possibly two men and the cost of fuel for producing the extra power, and you also have the advantage of being able to utilize the same steam you make the power with for heating the building. That is the case we have in the Board of Trade here. Now, under those conditions, I think it is perfectly evident that you can produce your own power for less money than you can buy it, because, with suitable additions—I mean with a plant of that sort or a little larger, with fuel at $3 a ton—you can produce a kilowatt hour and put it on the switchboard for about a cent and a quarter. That being the case, you can not afford to buy energy at from five to seven cents per kilowatt hour. I do not mean to say that I can produce it at that price, including wages and everything, as this is only the fuel expense, to which you must add the interest, and whatever attendant's wages should be charged to electric plant, which, by the way, you carry in the building any way. To do that would probably bring the cost up to three and one-half cents per kilowatt hour, and you can not usually buy it for less than five to seven cents per kilowatt hour.

Mr. Nichol: I would like to ask Mr. Arnold if the question of liability would not enter into that matter; that is, is there not less chance of accident and stoppage when taking it from the central station than when producing it from a comparatively small plant? And then, in addition to that, the space occupied in the printing office, taking in the center of the city, floor space is very valuable, in most cases it is chuck full of printing presses, so that there would be very little room for the steam plant and engine and dynamo.

Mr. Arnold: I do not think space is sufficiently valuable to prevent your occupying it for power. It is a question whether you want to buy it or whether you can generate the power yourself. The other point of always being attached to a central station is easily answered by the statement that we can design any plant on a certain system, whereby you can have a main switch capable of connecting the plant instantly with the central station, and you then have the central station to draw from in case of accident. That is one way. The other is to put in a duplicate engine or dynamo. Either one of these plans will meet the emergency.

Mr. Arnold: There was one thing I failed to say about the railroad question. I do not want the meeting to adjourn without setting myself right on it, and that is, that it is not going to be entirely a question of economy that is going to govern the equipment of steam roads with electricity; it is going to be a question of what is demanded by the patrons of roads on suburban service, and a case of railroads protecting themselves against competition with the trolley; therefore I expect a very marked increase, in the near future, in the application of electricity to steam roads. The demand of the traveling public, then, is what is going to bring the pressure, instead of very marked expected economy which is going to be effected in the consumption of fuel. There will be great economy to the roads in saving of labor, and that will pay the roads, but it will not come in the shape of fuel economy, except in special cases, as much as in the saving of labor. With these elements working in favor of electricity, it is fair to presume that the steam roads will equip short lines for suburban service as promptly as possible, and gradually extend the system by reducing the weight of their trains and running more of them, thus approaching the conditions favorable for electricity until a large number of the lines will become equipped electrically throughout their entire length, and especially and speedily will this be effected if the efficiency claimed by Dr. Jacques can be realized in practice.

Mr. Gibbs: Mr. Chairman, I hope Professor Jackson will feel justified, in the publication of his paper, in at least giving the class of manufacture referred to in each letter he quotes. If he prefers not to say definitely whether it is, for instance, a locomotive works or a cotton mill, if he will say "heavy" or "light machinery," it will be some guide in drawing useful conclusions. I recognize one of the establishments, that having about 1,500 horse-power of motors, and I was informed the other day at their works that the cost of repairs on electric motors—they have got 140—was considerably less than the former cost of belt repairs, and they are very much pleased in every way with the adaptability of electricity to shops manufacturing heavy machinery. The gain in appearance in their shops is really marvelous; it can not be appreciated without seeing it. In two or three shops they have one-half run by electricity and the other half by the old belt transmission, and it is like going from night to day, coming from the belted department to the motor-driven department. And I will say, further, that they have adopted a plan which I consider a good one, from a mechanical standpoint, of connecting their motors by short belting to the tools. This gives a flexibility in starting and stopping and relief from sudden strains; it is, in fact, a good mechanical proposition. I have seen, and we have discussed a good deal, the proposition of connecting motors into the head stocks of lathes by direct gearing, also of using motors direct connected without gearing. This can be done, but there does not seem to be any electrical or mechanical sense in doing it, and economically it is an absurdity, for in the case of an electric motor, as in a steam engine, the first cost will increase as the speed decreases.

In the locomotive shops we have not been able to go into electric transmission to any great extent yet, for the reason that the railroads have not been inclined to take up avoidable expenditures during the past few years. I do not expect, therefore, to see much development in this line until business improves. In our shops in Milwaukee we have outlined a number of applications that can be made to great advantage. One we have lately made may be of interest. We had an old walking crane, which ran on a single track and was propelled by a cotton cable running at a very high velocity, and which cost us a great deal for repairs. We found, by taking the current readings of a motor temporarily connected to the rope countershaft, that it took 15 horse-power to "idle" the rope and only two additional horse-power to lift the weight, or traverse the crane. We applied, at small expense, two steel-clad motors of three horse-power each to the crane, one for traversing and one for hoisting, and it has been operating to our perfect satisfaction for the past six months. We estimate we will pay for the equipment in cost of power saved in one year.

GOVERNING OF WATER POWER UNDER VARIABLE LOADS.

READ BEFORE THE AMERICAN SOCIETY OF CIVIL ENGINEERS, BY M. S. PARKER.

The government of water power under variable loads has always been considered a difficult problem under the most favorable conditions. Many operators of water-power plants where changes in load are great and sudden have found their government so uncertain and near the danger line that it was believed a few years ago that small electric street railway plants could not be successfully operated by water power. With large plants the change in load represents but a small percentage of the whole power in use, so that the variation in the load is not so extreme as to cause serious difficulty in the government of the power. It is the extreme and sudden change that causes trouble.

The modern ball governor, as used to regulate water-wheels, is satisfactory in its operation where the power used is fairly constant, but becomes entirely inadequate for the government of water power where the changes of load are sudden and extreme. The author had this problem of the government of water power brought to his attention a few years ago and found little published data to assist him in solving it. The solution became a matter of experiment.

The power to be governed consisted of a pair of 22½-inch Victor turbine-wheels working under 40-foot head. These wheels generated about 400 horse-power on the wheel shaft, which is used in operating six miles of electric street railway having a 20-minute service. On this line are employed from four to ten cars daily, equipped with two 15-horse-power single motors. Extremes of variable load are of daily occurrence. There are moments when, with four or more cars in service, the load is suddenly removed by the stopping of all cars at once, making a sudden change from a load of 120 horse-power or more to no load on the generators.

This was the cause of frequent annoyance and expense, due to the burning out of armatures, as the ball governor of the water-wheels does not act quickly enough to prevent racing of the wheels at times. A large fly-wheel roped with five two-inch diameter ropes from the wheel-shaft failed to hold the wheels always in check. When the wheel governor, assisted by the balance-wheel, succeeded in checking the speed, as frequently occurred, the recovery of the necessary power to operate the entire load was necessarily slow in action, causing delay in the starting of the cars. The water to operate the wheels mentioned is conducted from the head works at the dam to the wheels through a penstock nine feet in diameter and 400 feet long. The absence of a vent or standpipe on the penstock made the problem of government of power still more difficult of solution. It has been the practice among hydraulic engineers, so far as the author is aware, to disregard length of penstocks in designing water-power plants. From the author's observation and experience it is shown that the shorter the column of water in the penstock, the easier it can be regulated or governed in flow at the wheel; in other words, in reducing the time of getting power from the water to a minimum where long penstocks are indispensable, it will add greatly to the facility of governing the water if a standpipe is placed on the penstock near the wheels to be governed, of a diameter equal, or nearly so, to that of the penstock. The vent pipes, as generally used on such penstocks, are entirely too small to be of any material service in governing the water power developed.

A patented electric governor was obtained and has now been in operation for about two years, and has proved successful beyond all expectations. This electric governor consists of a gate regulator, a high-speed engine regulator and a common telegraph or gravity battery, with its circuit. The regulator is powerful enough to control the wheel gates, and receives its power directly from the wheels. It is also so sensitive that the battery current will cause it to move the gates as desired. The engine governor is simply used as an indicator of speed, and as the indicator rises or falls it makes an electric contact, telegraphing the regulator which way to move the gate. This governor is not an expensive piece of mechanism. Its construction is simple. The expense of maintenance for the time it has been in service has been nominal. While the author is not prepared to say that this is the best device on the market for the government of water power under variable loads, he can say that it is the best and least expensive device that has come to his notice, and that it has solved the problem of the government of water power under extreme variable loads in the instance herein cited.

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The latest rumor concerning Mr. C. T. Yerkes, the well known financier and street railway man, is to the effect that he has secured control of the elevated railways in Chicago. It is further believed that Mr. Yerkes will later appear at the head of a company to be formed by consolidating all the elevated roads. We hope the rumor is true. Mr. Yerkes is a genuine believer in electric traction, and if the report quoted is fulfilled, Chicago may rest assured that traffic on all her elevated railroads will be carried on by electric power.

Interest in the X ray continues unabated, and the thousands of intelligent experimenters now at work are rapidly broadening its field of practical usefulness. Many hospitals, and surgeons in private practice, have already secured their own sets of X-ray apparatus, and the day will soon come when no hospital or surgeon of ability can afford to be without an X-ray outfit. The manufacturers of this apparatus report a large and growing demand for their goods, and several of the larger houses have difficulty in keeping pace with their orders.

An important addition to the rapid-transit facilities of Greater New York is proposed in a tunnel for electric cars beneath the East River, starting near City Hall in New York and coming out near Furman street in Brooklyn. It is planned to thus unite the surface railroads of these two great communities so that passengers can travel from one to the other without change. This is an enterprise that should succeed, and the large capital necessary will undoubtedly be easily secured to carry it through to completion. The estimated cost is $3,500,000.

ARE TELEPHONE COMPANIES COMMON CARRIERS?

In Illinois, the home of a number of successful anti-Bell telephone exchanges, a bill has been introduced in the legislature declaring that all telephones are common carriers. According to its provisions every telephone company shall permit any other person or corporation, operating a telephone line, to connect with its wires by any device or system commonly used for long-distance telephones, and shall receive and transmit all messages that may be offered by the connecting company, and shall repeat or cause to be repeated as many times as may be necessary to a proper and distinct delivery of the message. As this is evidently part of the plan of the independent companies to compel the American Telephone and Telegraph Company (long-distance) to accept telephonic connection from their exchanges, the outcome will be watched with interest and will be important. At the present time only licensees of the Bell company connect with the long-distance system, and these only when telephone exchanges are specially equipped with the improved far-speaking instruments owned by the Bell company.

MR. PAYNE AS A CABINET OFFICIAL.

Mr. J. E. Keelyn, of Chicago, a prominent and enterprising anti-Bell telephone man, is opposing vigorously the suggestion of the selection of Mr. Henry C. Payne, of Milwaukee, as a member of President-elect McKinley's Cabinet. This opposition is based on the fact that Mr. Payne is financially interested in the Wisconsin Telephone Company, a licensee of the American Bell Telephone Company. With his accustomed energy, Mr. Keelyn has secured a long list of signers to a protest and forwarded the document to Canton. We can not see that the point is well taken. We do not believe that Mr. Payne's interest in a telephone company or any other reputable company would impair his usefulness or prejudice his judgment as a member of the Cabinet. As well could opposition be urged by private banks and State banks to the appointment of Lyman J. Gage, a National bank president, of Chicago, to the Secretaryship of the Treasury. As well might the few remaining horse-and-mule street-car interests oppose this appointment as prejudicial to their welfare, for Mr. Payne possesses large interests in electric railways, and is ex-president of the American Street Railway Association. It has not been announced that Mr. Payne is to be a member of McKinley's Cabinet, but if he is he will bring to that position tremendous energy, great executive ability and an experience in honorable politics that peculiarly befit him, in our opinion, for its responsibilities.

BOOK NOTICES.

"TRANSFORMERS FOR SINGLE AND MULTIPHASE CURRENTS," by Gisbert Kapp. Whittaker, London; MacMillan, New York. Price, $1.75.

This is a treatise by a very capable writer and electrical engineer on the theory, construction and use of transformers. The several makes of transformers are illustrated and described. It is dated September, 1896, and is consequently up-to-date. Supplied by the ELECTRICAL REVIEW.

"THEORY AND CALCULATION OF ALTERNATING CURRENT PHENOMENA," by Charles Proteus Steinmetz. W. J. Johnston Company, Publishers.

This book is by an able author, one who can speak and write with authority. It contains the very latest knowledge relating to alternating-current phenomena, much of which is original with the author and here appears for the first time in book form. The high standing of the author on the question of which he treats, and the original methods which he pursues in their exposition, makes this timely work one which will prove of great value to those interested in electrical engineering problems. Its price is $2.50, and it will be supplied, postage paid, by the ELECTRICAL REVIEW.

BURGLAR-PROOFING SAFES.

HOW THE CRACKSMAN WHO IS AN ELECTRICIAN MAY BE FOILED.

Some of the manufacturers and the banks might possibly profit by the following ruminations of the burglar editor of the ELECTRICAL REVIEW:

When it comes to pass that the modern burglar can attack a safe, using only a thick copper wire tapping a trolley circuit, and silently bore gaping holes in a few minutes, it behooves safe-owners and makers to stir themselves. But in what direction? If the burglar has only to make a huge arc, with the safe as a positive and a big carbon as the negative, and simply melt away the treasure barriers quickly and quietly, no ordinary safe can be made to withstand such scientific treatment.

Safe-makers can not go on with the sort of duel which for years past has been waged between naval engineers and gun manufacturers, armor against projectile. Safes must be manageable, and sufficiently portable, and greater weight or thickness seems out of the question. Mere choice of material can not go far. Various alloys of iron become very hard and drill resisting. But even a safe made of chromium itself, which is ordinarily infusible, would probably soon succumb to the nascent salvo of the electric arc. Besides, such a safe would cost more than its contents of gold, chromium commanding about $25 per ounce.

Manganese and chrome-steel both are admirable materials, but their qualities of resistance to cutting disappear before the electric arc. No metal or combination of metals can hold out against it. Hence it is suggested, and seriously, too, that the only ultimate protection the makers or owners can rely upon is an electrical alarm. But wherein is its protection absolute? The *fin de siècle*, enterprising burglar smiles at such a statement, like love and the locksmiths. He well knows how to silence bells, cut circuits or shunt currents where they will do him the most good. In the general range of electric alarms, your scientific burglar can "tell a hawk from a handsaw." And so long as he knows or can find out that a given safe is "protected" by an electric alarm, he is not much disturbed.

This is no disparagement of the utility of the electric alarm. But what type of alarm would or could prevent the gnawing of a hole in the safe-plates by the devouring arc?

There does seem possible a pretty good protection, however. The suggestion lies in a recently published invention for constructing prison doors and window gratings. The idea, as remembered, was to make them of ordinary steel pipes, all filled with a liquid under pressure, and connected by a main pipe with an alarm, which would operate by reduction of pressure. Attempted sawing lets the liquid escape and rings the bell. If such a scheme were applied to a safe, by traversing it on all sides, either inside the outer plates or outside, and were connected with an alarm set on a lamp-post prominent on the sidewalk, it ought to come near being good protection. The door could be arranged with piston and cylinder inside the safe, so that opening the door would set off the alarm. Then drilling at the lock, driving in the spindle or other successful attack on the lock would still leave the burglar at the mercy of the alarm when he opens the door. Nitro-glycerine, dynamite or powder would also effect the ringing of the alarm, and the plan would also protect against the electric arc itself, since the network of small pipes would be in the way of any large arc, and become melted. And a small arc for mere drilling at the lock would be no better than a drill, since the opening of the door would eventually ring the alarm.

The connecting pipes could be left exposed, because tampering with them would ring the alarm.

Or, instead of fixing the pipe system to the safe, construct it as a cage to contain the safe, the cage being large enough to make the safe inaccessible to the hands of the burglar.

Such a system would be protective, at least, until the burglar, already an expert electrician, had time to become a master plumber and pipe-fitter, and could invent schemes for beating the alarm.

Possibly the idea could be combined with an electric alarm, and all the machinations of the enterprising burglar made futile.

The Electric Conduit System of the Siemens & Halske Electric Company of America.

TO THE EDITOR OF ELECTRICAL REVIEW:

We have noticed from time to time both in the reading columns and advertising columns of your paper, that statements were made by certain competitors that they absolutely owned and controlled the patents covering all underrunning trolleys.

This statement does not refer to the Siemens trolley or contact bar, the well known device in use all over the world, which has been described repeatedly; it makes a sliding contact with the trolley wire, making overhead construction very simple and doing away with the necessity of switches and frogs, besides making it impossible for the device to be "off the trolley."

There were also statements in the papers that certain American companies had patents on electric railway conduits, and had installed what they pleased to term the "Budapest conduit system."

It is a well known fact that the first successful electric conduit system—the Budapest conduit system—was installed by Messrs. Siemens & Halske, Berlin, and all United States patents covering the main features of this system are owned and controlled by the Siemens & Halske Electric Company of America.

The Siemens & Halske Electric Company are prepared to furnish complete trolley stands and trolley contacts, and to install complete electric conduit railway systems under the patents they own and control, or they are willing to license prospective customers under these patents.

We think that these facts (and facts they are) will be undoubtedly of interest to many of your readers.

F. B. BADT, Secretary.

Chicago, January 28.

The Annual Report of the Central Union Telephone Company, Chicago.

At the annual meeting of the Central Union Telephone Company, of Chicago, the report showed that of the issue of $1,600,000 of bonds, authorized in July under the $3,000,000 mortgage, $1,275,000 were sold and paid for at 97½. This leaves remaining in the treasury of the company $325,000 bonds unsold. At the end of the year the company had a floating debt of $400,000, but it also had $98,000 of storehouse stock, all good for immediate use. This statement shows a sale of the bonds remaining in the treasury, and the charging of warehouse stock up to expenditures would enable the company to wipe out the floating debt. The statement of the president gave the following comparative figures on earnings and expenditures for 1896 as compared with the preceding year:

	1896.	1895.
Gross earnings	$1,327,931	$1,345,711
Expenses (exclusive of interest)	1,026,311	971,091
	$ 301,620	$ 374,619
Interest	64,530	23,124
Net revenue	$ 237,099	$ 351,495
Dividends paid	66,053	330,265
Surplus	$ 171,046	$ 21,230

In his report to stockholders President Stone said:

"In 1896, in addition to regular maintenance (repairs and ordinary reconstruction), there has been expended on extraordinary construction $118,822.05, which will be charged into expenses in maintenance account before the closing of the books. There has also been expended in new construction, approximately, $700,000, of which $425,000 has been expended at exchanges and $275,000 on metallic-circuit toll lines. The principal exchange work has been at Toledo and Columbus, Ohio, and Indianapolis, Ind.

"During the year there have been completed, approximately, 5,000 miles of wire of toll lines—lines between towns connecting exchanges—making the total number of miles of wire now in operation nearly 18,000, two-thirds of which are copper-metallic circuits of the most modern type. These facilities, in connection with the lines of the Long-Distance company, afford means of intercommunication between the cities and larger towns in almost all of the country lying between the Mississippi River and the seaboard."

The capital stock of the Central Union Telephone Company stands now at $6,605,300. There were represented at the meeting, either in person or by proxy, 44,647 shares out of the total of 66,053. There was only one ticket put in the field for directors for the year, as follows: C. H. Brownell, R. C. Clowry, C. R. Cummings, Arthur G. Fuller, F. G. Griggs, W. A. Jackson, J. Russell Jones, M. G. Kellogg, Henry B. Stone, John F. Wallick, Norman Williams. The stockholders were not informed as to when they could expect dividends to be resumed. The company paid dividends at the rate of five per cent a year until July, 1896, when they were discontinued, owing to the falling off in earnings and an increase in expenditures of the company. It is said to be the policy of the officers of the company to pay no more dividends until the earnings of the company are largely increased.

No Telephone Decision.

The United States Supreme Court adjourned until March, on Monday of this week, without deciding the Berliner telephone transmitter patent case, which is looked for with much interest in telephone circles.

The delay in rendering this decision is looked upon as adverse to the Bell company, the owner of the Berliner patent. It is supposed to mean a divided court, perhaps a decision in favor of the Government, the prosecutor of the suit.

A Handsome Exhibit of Westinghouse Glass.

For several years past it has been the custom for the glass manufacturers of Pittsburgh and vicinity to hold an exhibition of their products at the Monongahela House, Pittsburgh, during January. This is done so that the buyers for the large houses in the East and West may have an opportunity to inspect, at their leisure, the newest styles and forms of glassware about to be placed on the market. This exhibition, during January of the present year, has been remarkable both for its extent and for the quality of the samples shown. By far the best of these exhibits was that of the Westinghouse Glass Factory, of Pittsburgh. This exhibit was designed by and was placed in charge of Mr. J. H. Reid, the general sales agent for the factory.

The line of samples of electrical glassware shown by the Westinghouse Glass Factory was unusually complete and beautiful. The various forms of glass globes, pendants and shades were arranged on tables built in the form of steps and covered with black velvet. Each piece of glassware was placed over a socket containing a Westinghouse stopper lamp. The electrical circuit was so arranged that the lamps on one step could be lighted at one time, or current could be thrown on the whole table at once. Current was supplied through a transformer located on the side wall of the hotel from the local lighting mains. The design and arrangement of the Westinghouse goods, as exhibited in the largest and most prominently located parlor in the Monongahela House, reflects great credit on Mr. Reid's skill as a decorative artist and electrician.

While the Westinghouse exhibit included many marvelous creations of the glass-blower's skill applicable to oil and gas lights, the line of electrical glassware shown was probably the most important feature of the exhibition. The most interesting novelty placed on view by the Westinghouse Glass Factory was a new line of green and white glass shades for incandescent lamps. These shades are made of solidly colored glass, green outside and white inside. They are claimed to be far superior to the imported shades of this type. The dazzling white lining makes a very efficient reflector, and the fine luster of the green glass is remarkably beautiful. One form of this shade is splendidly adapted for bank and office use where a concentrated light, from the direct rays of which the eyes are protected, is in demand. The Westinghouse Glass Factory has published a booklet entitled, "Green and White," in which these new shades are illustrated and described. It will be sent free to any one upon request.

INTERESTING NOTES OF MODERN SCIENCE.

Platinum is the great contact metal in electrical work.

The depreciation of storage batteries is generally put down at 10 per cent per annum. Mr. Chas. F. Brush, of Cleveland, however, has had a large number in use for nine years, and yet they show no signs of giving out.

The Davy-Faraday Research Laboratory opened for practical work on January 18. Workers are entitled to gas, electricity and water (as far as available) free of charge, and, at the discretion of the directors, to the use of the apparatus and such chemicals as may be authorized. Those who desire admission as workers must send evidence of scientific training, on forms to be obtained of the Royal Institution.

A western inventor has developed an arrangement whereby the act of opening the furnace door to fire puts into operation an arrangement for injecting heated air into the furnace, and this injection continues for a predetermined time, being shut off automatically by the attached mechanism at the end of a period, the length of which is determined by experiment, which will allow of the combustion of the volatile constituents of the fuel.

The production of manganese increases every year. Russia produced, in 1894, 244,972 tons, while all other countries produced, in the same year, only about 193,000 tons. In 1895 Russia produced 248,000 tons. With the exception of Chili, France, Germany and Japan, the production of manganese ore has declined everywhere, especially in the United States. This is due to the growing competition of the Caucasian and Chilian ores.

It is said that 95 per cent of visual hallucinations in delirium tremens consist of snakes or worms, in one form or another. Dr. Davis has been investigating the subject in the alcoholic wards of Bellevue Hospital with the opthalmoscope, and has brought out some interesting facts. In every one of the 16 cases examined, the blood vessels of the retina were found to be abnormal. Instead of being pale and almost invisible, as in their ordinary condition, they were dark—almost black—with congested blood. The blood vessels of the retina, which are so small and semi-transparent in health that they are not projected into the field of vision, assume such a prominence that they are projected into the field of vision, and their movements seem like the twisting of snakes.

Mr. F. F. A. Tunbridge writes, concerning electric and light waves, that red light has a vibration speed of about 400,000,000,000 a second, the wave length being about 30-millionths of an inch. But it is a matter of extreme difficulty to get electrical oscillations of any magnitude with as great a frequency as 4,000,000,000 a second, which corresponds to a wave length of nearly three inches. The velocity at which the waves travel depends solely upon the medium of transmission, and is in no way connected with the source of the disturbance, and the length of the wave is simply this velocity divided by the rate of vibration. Thus, if one particular vibration is a million times as rapid as another, having only one-millionth the wave length, the speed of travel is necessarily the same. But while this is the case in free ether, on entering gross matter the velocity of all waves is retarded; but the smaller waves are, as a rule, more affected than the longer, and this fact is the cause of the phenomena of refraction and dispersion. It is quite correct that the shorter the wave length the less the penetrative power. To very long waves almost everything is transparent; to very short waves almost everything is opaque; and this fact, which may be proved both theoretically and practically, is one of the greatest arguments against X rays being merely extreme ultra-violet light. The absence of all retardation in speed on entering a denser medium (*i. e.*, refraction) is perhaps the other chief obstacle to this theory.

X-Ray News From Europe.

The Prussian Government has appropriated $12,000 for Roentgen-ray experiments during the current year.

Dr. Freund, of Vienna, has used the X rays as a depilatory. The experimenter tried them upon a boy whose spine was hidden by an abundant crop of hair. The malady is known to the profession as hypertrichosis. Dr. Freund turned the rays upon the boy's back, and the superfluous hair vanished, roots and all. The boy, no longer an infant phenomenon, has been shown to the medical society in Vienna, and photographs of his condition before and after are being shown in that city. In view of recent reports of experiments in this country, it is a little too early for the Vienna doctor to crow. It is said that after the X rays have destroyed the hair (the first case of which was reported in the ELECTRICAL REVIEW), after a time the hair grows again with more vigor than before. So the little Viennese may eventually prove a bigger freak than ever.

Professor Friedrich, of the Vienna Academy of Sciences, is reported in cable dispatches as having discovered certain black (?) rays that issue from the vacuum tube and pass through the human body. The photographs produced by means of these rays, which the professor calls "critical rays," are not the same when taken of a living body as from a dead one. Photographs of living hands show the skeleton as in the Roentgen photographs. A dead hand appears in full, showing all the fleshy integument, while the bones remain invisible. It is thought that, by means of these rays, it may be ascertained whether a person is really dead.

There is quite a reduction in the price of dry batteries, due to the competition of the manufacturers of the different makes. These low prices will have a tendency to crowd out a number of the liquid batteries.

PROTECTIVE DEVICES FOR TRANSFORMERS.

BY HERBERT C. WIRT, BEFORE THE NORTHWESTERN ELECTRICAL ASSOCIATION, JANUARY 20, 1897.

(*Concluded from page 41.*)

Professor Thomson's most prominent protective devices, developed in 1885, are known as the ground shield and grounded secondary. The ground shield consists of a sheet-metal covering placed in the transformer, between the primary and secondary windings, in such a way that it is impossible for any current to pass from the primary to the secondary windings without connecting with the metal shield. The shield is connected to a good ground, and therefore the primary current will not pass to the secondary wiring.

The most notable installation in this country of transformers with ground shield is at Elizabeth, N. J. The transformers were constructed to stand a 10,000-volt high-potential test from primary to secondary, and 5,000 volts from primary to ground shield.

There are 225 transformers installed, and they have been in operation about three years, and the total number damaged by lightning has been seven. The electrical engineer in charge reports that he has no records to show how many transformers were burned out by lightning previous to the time the ground shield transformers were installed, and he can therefore make no direct comparison. The lines extend some 250 miles overhead, running as far as nine miles from the station, and he thinks the district is very subject to lightning disturbances.

The lines are protected by 60 line arresters and an equipment of station arresters of an approved type. The engineer reports that whereas the ground shield seems to create more of a tendency for the lightning current to burn out the transformer, it has prevented the primary current connecting with the house circuit, and thereby endangering life.

We wish to state that the lightning arresters which are protecting these lines are of a type which require approximately 8,000 volts to bridge the gaps separating the line from the ground wire, and whereas the transformers are only insulated from ground shield to primary wires to stand 5,000 volts, it is evident that there is a possibility of the lightning current passing to ground through the transformers instead of through the lightning arresters.

Transformers fitted with ground shields are quite generally used in England, as these transformers meet the specifications of the Board of Trade.

In the grounded secondary system the house wiring is permanently connected to ground. This connection may be made from either side of the secondary, or carried from the middle point of the secondary winding in the transformer. In the latter case, there is a difference of half the potential of the secondary system existing between the secondary wires and the earth. If only one of the secondary wires is grounded, there exists a difference of potential between the earth and the other secondary wire equal to the full secondary voltage.

These systems, therefore, are objectionable from an insurance standpoint, as it has not been thought desirable to have the secondary system grounded, on account of the danger of leakage of the secondary current.

The film cut-out and Cardew earthing device have an advantage over permanently grounding the secondary, as there is less liability of a leak from wires to ground, except at the time when the devices are short-circuited.

A large installation in the town of Suncook, N. H., has been in operation during the past year, with a grounded secondary. The installation consists of 2,000 lights, located in several mills, and about 500 in the town. The generating station is located six miles from the town and mills; primary, 2,500 volts. A three-wire secondary system is used—100 volts on each side. The neutral wire is grounded. The lines are well protected by lightning arresters, which were not of the short-gap type.

Two transformers have burned out, but after a careful examination, the conclusion was arrived at that one of the transformers at least had been injured by water, as the transformer box had been opened during a heavy rain-storm. If the short-gap lightning arresters were used, there would be less liability of the transformers burning out.

It will be seen from the above that the lightning arrester is a very important protective device, as we must depend upon arresters to conduct the lightning discharges to the ground. If we did not use arresters it would be almost impossible to construct a transformer that would not burn out. We might use a protective device to prevent any danger from the current passing to the secondary wiring, but we would frequently have transformers burn out.

Arresters have heretofore been designed solely for the purpose of preventing the dynamo current maintaining an arc after the passage of the lightning discharge. A new arrester has been designed which affords an easy path to ground for the lightning current.

A careful test of the various arresters on the market to-day shows that the 1,000-volt arresters require from 3,000 to 4,500 volts, and the 2,000-volt arresters require from 6,000 to 9,000 volts potential to cause the current to pass from line to ground across the gaps.

As the insulation of the transformers can best be tested by a high-potential current, so also arresters should be tested by the same high-potential current, and they should be constructed so the current will pass across the gaps in preference to passing through the insulation of the transformer.

The necessity of a short-gap arrester has undoubtedly been known to many experimenters, but until recently no method was devised to permit the short-gap arrester to be used on high-voltage alternating currents. We are pleased to say that an arrester has recently been designed so that but one gap of one-thirty-second of an inch is

required for a 1,000-volt arrester, and two gaps of one-thirty-second of an inch each for a 2,000-volt arrester, requiring 2,000 and 4,000 volts, respectively, for the current to pass across the gaps.

It is believed that these arresters will afford protection to transformers provided with insulation that will stand a 5,000-volt potential test.

This arrester consists of large metal cylinders, separated by short air gaps in series, with which is placed a low non-inductive resistance to limit the current at short circuit. The arc is cooled so that upon the reversal of the alternating machine current it is extinguished.

Transformers having defective insulation between primary and secondary should be immediately disconnected. The only way to discover a transformer of this kind is to make insulation tests, and therefore it is apparent that periodical tests should be made of the insulation between primary and secondary of all transformers.

As a high-potential current is necessary, a small step-up transformer should be used, which can be carried around to the points where the transformers are located. This transformer should have a capacity of at least two kilowatts for testing transformers of 30 kilowatts capacity and less, in order to supply the capacity current.

In making a test the house transformer is disconnected from both the primary and secondary wires. The primary of the test transformer is connected to primary lines, which are energized by the alternator. The secondary is connected to the house transformer; one side to primary and the other to secondary. A rheostat, or reactive coil, is located in series with the primary of the test transformer, so the secondary voltage may be varied between the limits of 2,500 to 10,000 volts. A fuse should be located in the primary circuit to open when the insulation is punctured.

The high-potential current should be applied for 60 seconds, and any transformer that will not stand a 3,000-volt test should be scrapped. It will be found that the transformers that have poor insulation also have very high core losses and are not economical, for in many cases it will be found that the revenue obtained from the transformer will not be sufficient to pay for the coal used in generating the current to supply the iron core loss. Therefore, it will be most economical to scrap such transformers.

This test should be made as frequently as possible, and at least once a year. When making this test, the secondary should be connected with the iron core, as this acts as a condenser, and a high-potential current would be generated in secondary wires which would burn out the insulation between secondary wires and core.

Transformers are not generally tested for leakage between primaries and secondaries, and, as they are isolated on the line, there is no means of testing for leakage at the central station without extra wires. It is apparent that it is necessary to make frequent tests of this kind. An interesting method of testing transformers has been in operation at Great Falls, Mont., for the past two years. The secondaries of half a dozen transformers are connected to a common test wire, which is run to the central station, and tests are frequently made there between this test wire and each side of the primary circuit. The normal primary current of 2,080 volts is used for testing.

A fatal accident, and several cases occurred where persons had received severe shocks, and for this reason the electrical engineer in charge was most anxious to keep his transformers in good condition. A test made on transformers on the line disclosed the fact that three or four of the transformers had primary and secondary coils in contact. *All these transformers were not insulated with oil.* Since using the test wire, the system has been operated without accident, and a great saving of time has been effected by means of the test wire. It would seem that there might be many cases where this system would be of advantage.

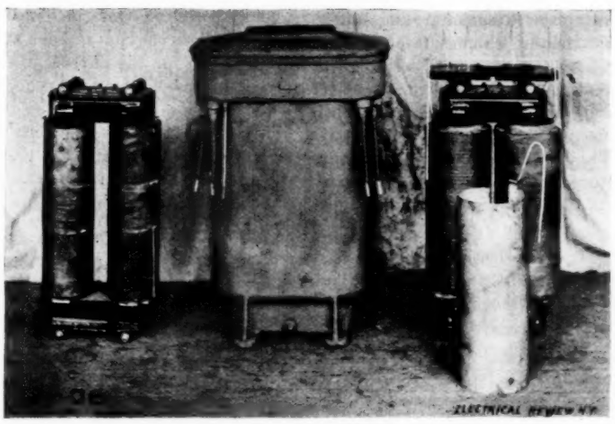


FIG. 3.—"PROTECTIVE DEVICES FOR TRANSFORMERS."—GROUND SHIELD OF TRANSFORMERS.

A fatal accident can only occur when the following connections are made:

1. A ground on one of the primary wires.

2. A leak between primary and secondary on the opposite side of the system on which the ground is located.

3. A person in circuit with the secondary and ground. As the majority of lamps are installed in locations where it is impossible to get a connection to ground, many chances of receiving fatal shocks are avoided. If the primary lines are kept free from grounds, no shock can be obtained. It is, therefore, essential to use the most approved appliances at central stations for indicating grounds on primary wires.

The most common ground detector in use at present consists of a transformer, the primary of which is attached to the line to be tested and the ground. The secondary winding of the transformer is in circuit with an incandescent lamp. The ground is indicated by the brilliancy of the lamp. This seems to be a very crude method of indicating grounds, as there is an opportunity of error, and the detector is connected only at stated periods. It has been said that alternating lines always have a slight ground, as the ground lamp always burns at a dull red. This is due to the capacity effect of the lines, and not to actual leakage of primary current.

The transformer system can be greatly improved in the following manner:

1. There should be used at the station and on outside lines short-gap lightning arresters that will permit the passage of the current across the gaps before the insulation of the transformers will be broken down.

2. Transformers operated on 3,000-volt circuits or less should be constructed to stand a high-potential test of 7,500 to 10,000 volts for 60 seconds between primary and secondary windings.

3. A safety device should be used in connection with transformers that will prevent any difference of pressure in excess of 300 volts between secondary wires and ground.

4. Transformers should be filled with oil.

5. Transformers should be periodically tested for insulation between primary and secondary with high-potential currents.

6. A ground detector, which will positively indicate a leakage of current from primary wires to ground, should be used at the central station. It should not be affected by the capacity effect of lines, and it should be designed to be left permanently in circuit.

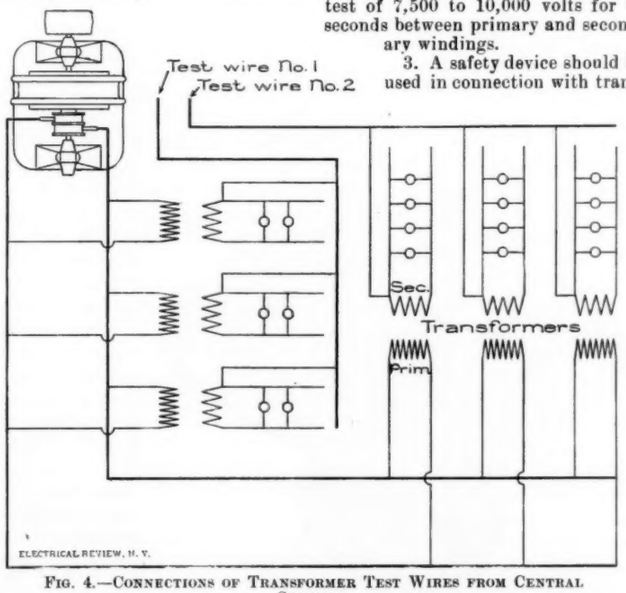


FIG. 4.—CONNECTIONS OF TRANSFORMER TEST WIRES FROM CENTRAL STATION.

THE DISCUSSION.

F. McMaster: How is the grounding core arranged so that there are no losses from induction in the protective device?

Mr. Wirt: The shield is a sheet of copper, and the ends are insulated so that there is no current passing in the shield. If you made a complete loop around the core, of course there would be current wasted in the shield.

S. Pierce: What kind of a device is recommended to be permanently left in the circuit, in order to show the ground which we could use there, that would not cause trouble in some other way?

Mr. Wirt: A static instrument can be used something like William Thomson's static voltmeter. Each line will form a coil and the capacity effects of line will balance, and if there is a leak the difference will be measured by an indicator. In the course of six weeks such an instrument will be on the market.

Prof. W. M. Stine: I would like to ask Mr. Wirt if there is any scientific connection between the high core loss and the low insulation in the second wire. Is one the consequence of the other, if you continue the excessive heating?

Mr. Wirt: There is no scientific connection between the two. I merely wanted to make it as easy as possible for the gentlemen to take off their old transformers. (Laughter and applause.)

W. W. Bean: If Mr. Wirt wants to make it as easy as possible for the gentlemen present to take off their old transformers, I hope the chair will not let this argument close until every electrical engineer is heard from, because we want to know something about the transformers before we buy them. If you know any other electrical engineers besides Mr. Pierce and Mr. Stine, let us hear from them. We are here for business, it seems.

Mr. Wirt: I might say that in the case of a transformer supplying my house, which has been in operation 16 months, being interviewed on the subject, I wanted to find out how much money the central station had made. I took the bills for 16 months down and measured the core losses, and found that the central station had made just enough money to pay for fuel for core losses, to say nothing of the energy lost in supplying the lights; so that, you see, is a very important subject to look into.

Caryl D. Haskins: I think there might be some connection between the poor insulation and core losses. Poor insulation may result in heating, which may very readily break down such insulation as is used in insulating the plates of the core one from the other, and that would cause increased current losses; so I think Mr. Wirt's point is very well taken.

The thanks of the association were tendered Mr. Wirt.

Sandusky Electric Railway in a Receiver's Hands.

The Sandusky, Ohio, Electric Railway Company, operating several miles of street-car lines, went into the hands of a receiver last week upon application of several stockholders in the company. Clark Rude was appointed receiver. The petition for the appointment states the company is behind in its interest and bonds, and employés have not been paid for several weeks. The indebtedness of the company is about $120,000.

The "Keystone" Types Switchboard Instruments.

After a number of years' study of the theory and practice of electrical measurement, several improved forms of the well known switchboard instruments made by the Keystone Electrical Instrument Company, Ninth street and Montgomery avenue, Philadelphia, are now being introduced.

The advantage of the most accurate and reliable measuring and indicating instruments is so marked that reference hardly need be made to the subject. The difficulty has been to incorporate for practical service, with no element subjecting the instrument to change or deterioration, mechanical strength and the power of indicating correctly the potential or current flowing in either direct or alternating circuits. To produce an instrument correct in principle, in which was incorporated no permanent magnets, for use on direct-current circuits, was comparatively simple, but to so adjust and modify this instrument that the effects of self-induction were eliminated when used on the alternating-current circuit, and produce an instrument which in itself would integrate correctly the alternating pulse in its theoretical and commercial form, and indicate directly the "square root of the mean square," or effective (sometimes called virtual) potential or current strength, was far more difficult. The Keystone Electrical Instrument Company claim to have accomplished this beyond their own expectations.

Fig. 1 shows the type "K illuminated dial" instrument, the ordinary type "K" shown in Fig. 2 being without the illuminating device, but exactly similar in all other respects. Both of these instruments are handsomely finished in brass, grained by hand and lacquered. They are made in all ranges, both volt and ammeters, and are combination instruments; that is, will read with equal accuracy on either direct-current circuits or alternating-current circuits of any frequency. The company claim to have been the first to put such a switchboard instrument on the market.

Fig. 3 shows the type "R" instrument; the mechanism is similar to the type "K," but the case is smaller and is made in full nickel. The type "R" instruments are with combination systems, the same as type "K," or without. The latter is cheaper and very satisfactory when an instrument is wanted on one circuit only; they are calibrated for direct current or for alternating current of any specified frequency.

Fig. 4 shows the company's galvanometer ground detector mounted in a brass case grained and lacquered. This instrument is very useful in showing the extent of grounds and in indicating on which side of the line they are; it is intended to be left in circuit continually; it is designed for either direct or alternating current, as desired.

The Keystone company also manufacture differential voltmeters mounted in type "K" cases with or without illuminated dial. The instruments are very useful when one or more direct-current dynamos are run from the same set of bus bars. The workmanship and material of these instruments are of the best; the cases are dust-proof; the bearings are jeweled, the counters dead beat, and the moving parts are shielded from the defects of external magnetism; the ranges can be made anything desired.

These instruments are calibrated to the finest standards before leaving the factory, which is equipped with the latest and best standard units and testing appliances.

Fig. 1.—Keystone Switchboard Instruments.—Illuminated Dial Voltmeter.

Fig. 3.—Keystone Type "R" Voltmeter.

Fig. 4.—Galvanometer Ground Detector.

Fig. 2.—Keystone Voltmeter without Illuminated Dial.

The building of the Joliet, Ill., Light and Power Company has been destroyed by fire. Loss, $75,000.

ELECTRIC LIGHT FLASHES.

The Hagerstown, Ind., Electric Company has purchased ground and will construct a new 800-horse-power electric plant.

The Lynn, Mass., Gas and Electric Company, at its annual meeting day, reduced the price of gas from $1.10 to $1 per 1,000 feet, and reduced the price of incandescents two cents on 1,000 metres.

The Toronto, Ontario, Electric Light Company has put in a new alternating plant for the purpose of supplying cheaper light to private houses. Under the new conditions the cost of lighting dwellings by electricity will be reduced 33⅓ per cent. At present the discount allowed those who pay promptly is 40 per cent. This will be increased to 60 per cent, but only to dwelling houses.

The report of the city electrician shows that the Alameda, Cal., electric light plant represents an investment of $67,439. The running expenses for the year, including salaries, fuel and supplies, were $10,631.95, or a monthly average of $885.99. The total receipts were $14,150.95, leaving an excess of receipts amounting to $3,519.05.

At the annual election of the stockholders of the Reading, Pa., Electric Light and Power Company, the following directors were elected for the ensuing year: Jerome L. Boyer, Levi Quier, O. W. Stager, Jno. G. Mohn, Jas. Nolan, Henry Darling, J. K. Righter. Secretary and treasurer, J. K. Righter. Jerome L. Boyer was re-elected president.

It is reported from St. Louis that the Edison company is arranging to reorganize, in order to decrease the interest charges on $4,000,000 worth of bonds, under which it labors at present. Each holder of a $1,000 six per cent bond is to be offered a new $500 four per cent bond and 10 shares of preferred and 10 shares of common stock in the reorganized concern. This would reduce the bonded indebtedness by $2,000,000 and the annual interest charges from $250,000 to $100,000.

THE INCLOSED ARC LIGHT.

DELIVERED BEFORE THE SOCIETÉ INTERNATIONALE DES ELECTRICIANS, PARIS, FRANCE, JANUARY 20, 1897, BY L. B. MARKS, M. M. E., OF NEW YORK CITY.

(Continued from page 39.)

The next step in the development of the inclosed arc light gives us the method and devices which are in successful use at the present time. Before taking up this branch of the subject I shall submit to you a short report of life tests and experimental investigations, made with the old equipment which I have already shown you. The length of cylinder used was 16½ centimetres over all, the diameter of body seven and two-thirds centimetres, and the capacity five-eighths litres. The memoranda on effect of introducing various ingredients into the carbons, and on the influence of different gases on the arc, are digested from elaborate notes and observations, and are given rather with the idea of recording the general results than analyzing the details of each experiment. I shall also refer to other phenomena observed in using this cylinder, especially that known as "building" of the negative electrode.

Table of life tests; cylinder with valved cap. Carbons, 11.11 millimetres in diameter.

Diameter of hole in valved cap. (In millimetres.)	Mean current. (Amperes.)	Mean arc tension. (Volts.)	Mean energy. (Watts.)	Consumption (—) carbon per hour. (In millimetres.)	Consumption (—) carbon per hour. (In millimetres.)
11.15	7.97	63.11	503.49	2.222	.102
11.905	7.96	62.9	500.68	1.988	.312
12.7	7.99	62.98	502.21	1.905	.424
14.287	7.99	62.8	501.77	2.328	.424
17.46	8.0	61.1	496.80	2.753	.534
28.575	7.94	62.8	498.69	11.536	8.077

LIFE TESTS; CYLINDER WITH VALVED CAP.

In the table following the comparative measurements are recorded showing the life of the upper and lower carbons, respectively, for different sized openings in the metallic cap or plug. It will be noted that in the first test the diameter of the opening in the plug is only a shade greater than that of the upper carbon; in next to the last test the diameter is 6.35 millimetres larger than that of the carbon, while in the last test the plug is removed from the cylinder. As is very natural the life decreases rapidly as the opening is enlarged, but, as shown in the tests, does not necessarily vary directly with the size of the opening. In each of

the tests recorded the arc was started at a point slightly higher than the center of the bulb. It will also be seen that the life of the negative decreases much more rapidly than that of the positive, as the ingress of oxygen into the inclosure is increased. Thus, when the positive carbon fitted tightly in the opening in the plug,

$$\frac{\text{life (+)}}{\text{life (−)}} = \frac{2.222}{.102} = 21.78.$$

When the diameter of the opening in the plug was 6.35 millimetres larger than that of the carbon, the excess of oxygen due to enlarged opening attacked the negative vastly more than the positive, resulting in

$$\frac{\text{life (+)}}{\text{life (−)}} = \frac{2.753}{.534} = 5.16.$$

When the plug was omitted the disparity became still greater, and

$$\frac{\text{life (+)}}{\text{life (−)}} = \frac{11.556}{8.077} = 1.43.$$

In another table I give the results of life tests, in which the position of the arc was shifted from the extreme upper part to the extreme bottom of the cylinder. It will be noted that in the first test the negative was 158.75 millimetres long, while in the last it was only 66.116 millimetres long. As the arc shifts in position from the top towards the bottom of the cylinder the life of the carbons decreases. This is due to strengthening of the convection currents as the negative burns away and consequent increase in admission of oxygen.

Table of life tests; cylinder with valved cap. Carbons, 11.11 millimetres in diameter; mean current, eight amperes; mean arc tension, 63 volts.

Position of arc in cylinder.	Mean length of arc. (In millimetres.)	Consumption of (+) carbon per hour. (In millimetres.)	Consumption of (−) carbon per hour. (In millimetres.)
Near top.....	158.75	2.362	.266
Between center and top.....	140.97	2.921	.266
At center.....	123.19	3.683	.393
Between center and bottom...	95.25	3.073	.660
Near bottom....	6.12	4.825	.965

INFLUENCE OF THE SURROUNDING ATMOSPHERE AND OF THE CONSTITUENCY OF THE ELECTRODES.

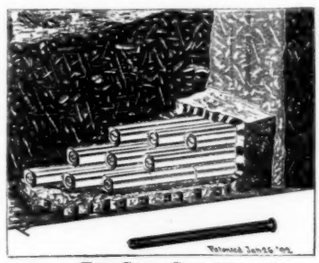
1. Hydrogen introduced through a hole in the positive carbon: Tests made through range of 6 to 11 amperes and 60 to 77 volts at the arc, voltage of the mains being practically constant and equal to 120. There was only a slight variation in the length of the arc throughout this range, the maximum length being 2.36 millimetres and the minimum 1.65 millimetre. Thus it will be seen that the presence of hydrogen tends to increase the resistance of the arc greatly, thereby shortening it to about one-sixth its normal length in carbon gas, for the same current and voltage. The arc is also unsteady and the light cut down to a large extent. It may be noted here that when moisture has settled in the bulb or carbons of an ordinary inclosed arc, there is a tendency towards reproduction of the above conditions, the arc, in such a case, being very short and unsteady at start and remaining so until the moisture has been dissipated.

(To be continued.)

VITRIFIED CLAY CONDUITS.

THE CAMP PATENT MANDREL AND GASKET SYSTEM OF CONSTRUCTION.

The almost universal move toward placing under ground in municipalities the electric wiring system has developed a number of very superior forms of conduits, among which the Camp system is worthy of special consideration. It has already been adopted by many of the most important western telephone, electric light and railway companies, and, in fact, also in the East, being in use by the New England Telephone and Telegraph Company at Boston. Although the form of the conduit is generally known by those who have studied subway questions, a description of it and the method of laying may not be out of place at this time. A feature which strongly recommends it is its simplicity for construction, as it is made in links which facilitate rapid and accurate handling, being laid like bricks in mortar or cement, so as to break joints in the middle of each length. This makes it capable of



THE CAMP CONDUIT.

sustaining great weight in cases where undermining occurs, as it lies in one solid cemented mass, though it may be laid with or without concrete, the concrete being necessary only to protect it against accidental injury from future excavations, it not being required to support the conduit. As shown in the illustration, it can be laid to receive any number of cables for telephone, telegraph and electric light, and is made large enough in diameter to insure a full three-inch duct as a standard size, other sizes being made according to specifications. The illustration also shows the mandrel, which is 30 inches long, with the rubber gasket on the end a little larger than the diameter of the duct, which is drawn through each duct as the work progresses. The advantage of this is evident, as it prevents the possibility of shoulders, while the gaskets wipe out any dirt or cement that may get into the holes. The conduit is made from the best clay, well glazed, and is said to last practically for an indefinite period under ground. Among some of the important companies using this conduit are the United States Electric Light Company, Washington, D. C.; Cleveland Telephone Company, Cleveland, Ohio; the Chicago Edison company, Chicago; Cataract Construction Company at Niagara Falls, the Bell Telephone Company, Buffalo, and many other prominent companies, whose acceptance is an excellent recommendation as to its advantages.

Electric Railways.

The power-house of the East Liverpool, Ohio, & Wellsville Electric Railway Company has been sold for delinquent taxes, amounting to $817.98.

The board of directors of the Ottawa, Can., Electric Railway Company was re-elected as follows: J. W. McRae, G. P. Brophy, William Scott, T. Ahearn, Thomas Workman, Peter Whelen, Warren Y. Soper. Mr. Redmond Quain was reappointed auditor.

The annual report for 1896 of the Ottawa, Can., Electric Railway Company shows that the total number of passengers carried in the electric cars in 1892 was 1,520,405, with receipts of $71,698.99. In 1896 the number of passengers carried was 4,583,235, with receipts of $212,105.85. This is very creditable progress.

At the annual stockholders' meeting of the Fort Plain & Richfield Springs, N. Y., Railroad Company, the following officers for the ensuing year were elected: Charles Seidler, J. C. Holden, J. G. Janeway, Robert D. Farlee, W. J. Kent and A. M. Farnum, of New York; Warren Hawn, Starkville; Andrew R. Smith, Springfield Centre; Dr. Norman Getman, Richfield Springs.

Under city ownership the street-railway fares in Glasgow are fixed at 1, 2, 3 and 4 cents, according to distance. During the first 11 months (July 1, 1894, to June 1, 1895) 57,046,640 passengers were carried at an average fare of less than two cents. Thirty-nine per cent of the fares were only one per cent. For the second year they show a net profit of more than $200,000, after allowing for interest, taxes and depreciation.

The 150 new Summer cars ordered by the Metropolitan Street Railway Company, for its Broadway line, are to be the finest cars ever built for the purpose, in keeping with New York style. The Stephenson's are making the car bodies and the Peckham trucks are to be used. As before announced, the Sterling Supply and Manufacturing Company will equip the cars with the latest things in registers, fenders, brakes, sand boxes, etc.

At the annual meeting of the stockholders of the East Hartford, Ct., & Glastonbury Street Railway Company, which is controlled by the Hartford Street Railway Company, the following directors were elected: P. Henry Goodrich, of Glastonbury, and James J. Goodwin, Daniel R. Howe, Atwood Collins, Leverett Brainard, E. S. Goodrich, John R. Redfield, George D. Curtis and Samuel G. Dunham, all of Hartford. At a subsequent meeting of the directors the officers were re-elected, viz.: President, E. S. Goodrich; vice-president, Samuel G. Dunham; secretary, George D. Curtis; treasurer, Daniel R. Howe.

The outlook for the trolley road between Penn Yan and Branchport, N. Y., is considered fair. The committee which has canvassed Branchport during the week has secured $6,200 of the quota of $10,000, and Keuka College authorities give assurances that $10,000 will be forthcoming there when required, and it is thought that Penn Yan will raise her quota of $10,000. Another road, it is claimed, is being planned for Steuben and Yates counties by other capitalists. The project is to extend the New York & Pennsylvania Railroad from Canisteo to Bath, and then down the Cohocton Valley to Savona. Then the line would follow the old roadbed of the Corning & Sodus Bay Railroad through Sonora, Bradford, Tyrone, etc., to Penn Yan.

The Mousam River Electric Railway, of Sanford, Me, will soon pass under the control of a syndicate of Boston capitalists, who will extend the road to Kennebunkport and Cape Porpoise, connecting with the eastern division of the Boston & Maine at Kennebunk Depot, and with the western division of the same road at Kennebunk. It is expected that the new road will be in operation by July 1. The proposed road will open eight water privileges along the Mousam River, aggregating nearly 4,000 horse-power, and will bring the up-country towns in communication with the towns and cities along the coast. The road will be operated by water power taken from the old falls, which were bought by the Mousam River Railroad some time ago.

GENERAL NOTES.

The ELECTRICAL REVIEW is indebted to the considerate New England Engineering Company, of Waterbury, Ct., for a convenient telephone directory and book holder.

It is expected that the E. S. Greeley & Company will pay in full. This will be a decided compliment to careful management of the assignees, General Greeley and Mr. J. W. Sands.

The Edison Electric Illuminating Company of New York enjoyed the following earnings (inclusive of high-tension systems) for December:

	1896.	1895.	Increase.
Gross.....	$246,275 78	$214,117.70	$32,158.08
Net.....	133,118.60	110,323.96	22,794.64
Gross, 12 mos..	2,247,437.83	2,000,855.93	246,581.90
Net, 10 mos., less deprec'n	960,156.94	835,680.83	124,476.11

General Passenger Agent Scull, of the B. & O. Railroad, recently estimated that the inauguration travel would be nearly double what it was four years ago. The improvements that have been made on the B. & O. within the past year will enable him to easily handle 50 per cent more people than ever before.

We have received from the General Electric Company a copy of their new catalogue, describing and illustrating railway apparatus and supplies. It is a book of 226 pages, conveniently indexed, and evidently contains within its covers everything essential to the proper equipment of an electric railway. It will be appreciated by street railway men.

ADVANCE INFORMATION

Electric Light and Power.

MANKATO, MINN.—The council have voted to receive bids on February 6 for an arc electric lighting plant and for the bonds necessary to pay for the plant.

ANGELICA, N. Y.—It is reported that an electric plant is to be established here at a cost of $13,000.

FLORENCE, ALA.—A. P. Harland can give information concerning electric plant.

LANCASTER, KY.—The Mayor may be addressed for information concerning electric light plant.

GAINESVILLE, GA.—C. E. King may be addressed concerning construction of two electric power-plants.

SCRANTON, MISS.—J. D. Clark may be addressed concerning contemplated construction of electric light plant.

ROLLA, MO.—The Rolla Electric Light and Power Company has been incorporated by Henry Bedlow, A. S. Long and M. A. Shawan. Capital stock, $3,500.

WEBSTER GROVE, MO.—The Mayor may be addressed concerning construction of a $20,000 electric plant.

OXFORD, N. C.—The Mayor may be addressed concerning erection of electric light plant.

ADA, OHIO—The Commissioners may be addressed concerning electric light plant for court-house and jail.

WILMINGTON, DEL.—City Clerk may give information concerning electric light plant.

FREDERICK, MD. — Cumberland County Clerk may give information concerning electric light plant.

FLEMINGSBURG, KY.—Mayor may give information concerning electric light plant, for which about $5,000 will be expended.

BERKELEY, VA.—Town Clerk may be addressed concerning electric light plant.

MORRIS, MINN.—W. P. Fowler is interested in establishment of electric light plant.

SOUTH MILWAUKEE, WIS.—A. B. Stetson is interested in electric light plant.

KANSAS CITY, MO.—A new electric light company will be organized.

FREMONT, OHIO — The Creager Electric Light and Power Company has been granted a franchise to construct an electric light plant.

GLOVERDALE, CAL. — An electric light plant is to be established here.

New Electric Railways.

TITUSVILLE, N. Y.—A company has been organized in this place, with a capital of $100,000, to build an electric road from Pleasantville through Titusville to Hydetown.

NAPA, CAL.—The Napa County Supervisors have granted to the Clear Lake Electric Power Company a franchise for an electric power line over the county roads through Napa, Pope, Conn and Chiles Valleys from the Solano County line to the Lake County line.

FREDERICK, MD.—A company has been organized in this place to build an extension of the Frederick & Middletown Electric Railroad from this place to Myersville, a distance of about five miles. Col. D. C. Winebrenner, of Frederick; Maurice E. Brightbill, Annaville, Pa.; George W. Wachtel, George O. Toms, John C. Leatherman, of Myersville; Cyrus F. Flook and Reno S. Harp, of this city, are interested.

DOYLESTOWN, PA.—It is proposed to extend the Quakertown & Springtown trolley railway, now in course of construction, to Argus, Trumbauersville, Tylersport, Schlictersville, Sellersville and Perkasie.

New Telephone and Telegraph Companies.

WATSEKA, ILL.—The Eastern Illinois Telephone Company has been incorporated to operate an exchange; capital stock, $15,000. Incorporators: W. H. Harry, H. W. Snow and Z. E. Patrick.

WAYCROSS, GA.—The Southern Telephone and Telegraph Company is putting in a local system in this place. The new service will be ready by the 15th. The lines of this company, which run from West Florida, will soon be extended to Savannah, Brunswick and Jacksonville.

Business Troubles.

RACINE, WIS.—Hiram J. Smith has been appointed receiver of the Belle City Railway Company on application of the Sterling company, of Chicago.

SANDUSKY, OHIO—The Sandusky Electric Railway Company, operating several miles of street-car lines, has gone into the hands of a receiver. Clark Rude was appointed receiver.

Increase of Capital Stock.

DEPERE, WIS.—The Depere Electric Light and Power Company has increased its capital from $20,000 to $30,000.

Not Damaged by Fire.

The Metropolitan Electric Company, of Chicago, report that they were only slightly damaged from the large fire which occurred in the adjoining buildings on the night of January 26, as the fire did not reach them at all, and their slight damage was from water only. They are now running on full time.

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Allsop's "Practical Electric Light Fitting;" a treatise on electric light wiring and fitting. Price $1 50
Badt's "The Dynamo Tender's Hand-Book." Price 1 00
Badt's "Electric Transmission Hand-Book." Price 1 00
Badt's "Incandescent Wiring Hand-Book;" containing full instructions for incandescent wiring. Price 1 00
Noll's "How to Wire Buildings." Price 1 50
Crocker-Wheeler's "Practical Management of Dynamos and Motors;" description and directions. Price 1 00
Buckley's "Electric Lighting Plants;" cost and operation. Price, 2 00
Thompson's "Polyphase Electric Currents," etc. New. Price ... 3 50
Crocker's "Electric Lighting;" for the use of electricians, students and others interested in the installation or operation of electric lighting plants. Price 3 00
Latimer's "Incandescent Electric Lighting;" a practical description of the Edison System. Price 50

ELECTRIC RAILWAY.

Perry's "Electric Railway Motors;" their construction, operation and maintenance. Price 1 00
Merrill's "Reference Book of Tables and Formulas for Electric Street Railway Engineers." Price 1 00
Trevert's "Electric Railway Engineering;" embracing practical hints upon power house, dynamo, motor and line construction; for the use of students. Price 2 00
Verity's "Electricity up to Date, for Light, Power and Traction." Price 1 00
Hutchinson & Phillip's "Westinghouse Electric Street Car Equipments." Price 1 00

TELEPHONE.

Allsop's "Telephones: Their Construction and Fitting." Price 2 00
Hopkin's "Telephone Lines and Their Properties;" design and construction of city lines. Price 1 50
Poole's "Practical Telephone Hand-Book." New edition. Price 1 50
Webb's "Telephone Hand-Book." Price 1 00
Lockwood's "Practical Information for Telephonists." Price 1 00
Haskin's "Telephone Troubles and How to Find Them;" a complete hand-book for telephone inspectors. Price 25
Bennett's "Telephone Systems of Europe;" new and very complete. Price 4 50
Preece & Stubb's "Manual of Telephony." Price 4 50
Houston & Kennelly's "Electric Telephony." Price 1 00

MISCELLANEOUS.

Cushing's "Standard Wiring." Price 1 00
Thompson's "Dynamo Electric Machinery." Price 6 00
Unwin's "Development and Transmission of Power from Central Stations;" a new and timely book. Price 3 50
Meadowcroft's "A B C of Electricity." Price 50
Tesla's "Inventions and Researches;" by T. C. Martin. Price 4 00
Edison's "Life and Inventions;" by W. K. L. and A. Dickson. Price 4 50
Trevert's "How to Build Dynamo Machinery." Price 2 50
Parkhurst's "Electric Motor Construction for Amateurs." Price 1 00
Benjamin's "Age of Electricity—From Amber-soul to Telephone." Price 2 00
Foster's "Central Station Bookkeeping." Price 2 50
Houston's "Dictionary of Electrical Words, Terms and Phrases." Price 5 00
Replogle's "Electricity and Water Power." New. Price 1 00

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Kindred.... ...Interests

The Metropolitan Electric Company, of Chicago, has been given the western agency of the Bernstein lamps, both arc and incandescent. These lamps are amongst the best sellers on the market, and those not already using them would do well, the Metropolitan says, to give them a trial.

The Bristol Company, Waterbury, Ct., have issued a carefully prepared sheet, showing the sizes of the "Bristol" recording voltmeters, amperemeters and wall meters, which will be of value in the designing of switchboard work, illustrating also special styles of terminals for heavy currents. The demand for the instruments, the president, W. H. Bristol, says, is most encouraging.

The 100 and 150-hour, direct-current constant-potential arc lamp is rapidly securing exclusive control of this particular field of arc lighting. The Electric Appliance Company, of Chicago, as general western agents for the Upton arc lamp, are glad to report that they will soon be prepared to supply their customers with a long-burning Upton arc lamp, which has features not possessed by any other lamp on the market, the particular one being the entire absence of feeding or regulating mechanism. The experimental lamps turned out up to date have given splendid results.

Consolidation of Telephone Manufacturing Interests.

The Williams & Abbott Electric Company and the Kirk-Latty Manufacturing Company, both of Cleveland, Ohio, have consolidated, and hereafter the latter, the Kirk-Latty Manufacturing Company, will be the sole manufacturers of the old companies' lines. They will also manufacture a complete line of magneto bells, switchboards, telephone receivers, telephone supplies and electrical and mechanical devices. They are now building a new factory and are equipping it with modern machinery, and will have facilites for turning out these goods in large quantities.

WANTED, POSITION.

A THOROUGH MECHANIC, accustomed to all kinds of electrical, machine and bench work, able to take charge of shop, desires a position. *Address, "A. B,"*

116 Webster Ave., JERSEY CITY HEIGHTS.

PROPOSALS FOR ELECTRIC LIGHT PLANT AT HAWKINSVILLE, GEORGIA.

SEALED PROPOSALS will be received by the Mayor and City Council of Hawkinsville, Georgia, until 4 P. M., Wednesday, February 17, 1897, for erecting and installing complete an ELECTRIC LIGHT PLANT. The proposed plant embraces 40 1,200 c.-p.-arc and 750 16-c.-p. incandescent lamps.

Plans and specifications will be on file, and may be seen at the office of the Mayor, and copies of specifications, forms, etc., may be obtained from the Mayor after January 30, 1897.

The right is reserved to reject any, or all, bids.

S. A. WAY, *Mayor.*

J. L. LUDLOW, *Engineer.*
Winston, N. C.

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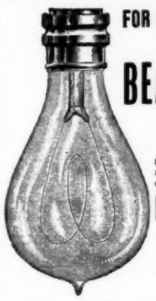

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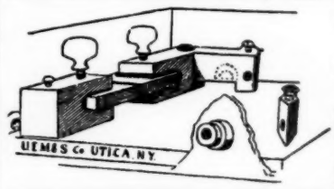

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3 M. P. 500, 666 horse-power, 500-volt generators with station equipments.
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1 D 50, 55 horse-power, 220-volt generator with station equipment.
1 D 25, 28 horse-power, 500-volt generator with station equipment.

RAILWAY MOTORS.

15 W. P. 50, 25 horse-power motors.
15 F. 30, 15 horse-power motors.
20 G. E. 800 drum armatures, 4 turn, new.

STATIONARY MOTORS.

1	1½	horse-power,	110 volt,	Thomson-Houston.
1	15	"	110 "	"
1	7½	"	110 "	"
1	1½	"	220 "	Robinson-Foster.
2	½	"	220 "	Edison.
1	2	"	220 "	Eddy.
1	3	"	220 "	Edison.
1	3	"	220 "	Thomson-Houston.
1	15	"	220 "	Belknap, new.
2	1	"	500 "	Ketchum, new.
1	3	"	500 "	Thomson-Houston.
1	5	"	500 "	Eddy.
1	5	"	500 "	C. & C.
1	10	"	500 "	Lundell.
1	25	"	500 "	Thomson-Houston.
1	50	"	500 "	"

And many others not mentioned above.
All motors have sliding base frames and fireproof rheostats.

ELECTRIC PUMP.

A 10 horse-power, 500-volt Thomson-Houston motor, direct connected to Goulds pump, capacity, 10,000 gallons per hour.

125-VOLT INCANDESCENT DYNAMOS.

4	6	Kilowatt,	110-light,	Edison.
3	12	"	210 "	"
1	15	"	270 "	"
2	20	"	360 "	"
1	30	"	540 "	"
1	7½	"	125 "	T.-H.
1	15	"	275 "	" "E. I." type.
3	30	"	540 "	" "H. I." "

1 1,000-light M. P., Westinghouse.
1 85-light, Westinghouse.

ALTERNATING DYNAMOS.

1	A 35,	650-light,	Thomson-Houston.
2	A 120,	2,000 "	"
2		650-light,	Westinghouse.
2		750 "	"
3		1,000 "	"
1		1,500 "	"

The above are all 1,000-volt machines, and are complete with exciters and station equipments.

ARC DYNAMOS.

1		5-light,	2,000 candle-power,	Brush.
1	5	"	1,300 "	"
1	20	"	2,000 "	"
4	30	"	2,000 "	"
1	45	"	1,200 "	" New.
2	50	"	2,000 "	" Thomson-Houston.
4	45	"	1,200 "	" "
1	80	"	2,000 "	" "
2	30	"	1,200 "	" "

ARC LAMPS.

15 K. 12, 1,200 candle-power, single, Thomson-Houston.
10 1,200 candle-power, single. Brush.

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A large lot of Stanley transformers, from 15-light to 100-light, 1,000-volt primary; part 50-volt secondary, and part 100 volt secondary.

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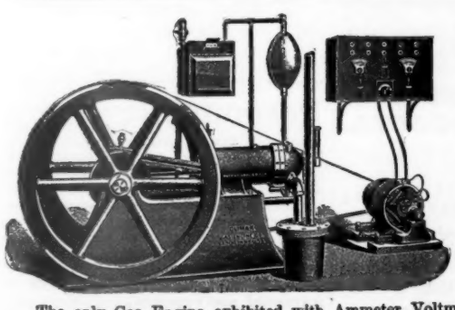

AT full load we guarantee voltage fluctuation not exceeding two volts, and gas consumption not exceeding 50 cubic feet per kilowatt hour, equal to from 16 to 25 full powered 16 candle-power lamps, according to wattage of lamp used.

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The only Gas Engine exhibited with Ammeter, Voltmeter and Gas meter in full view, which enables intending purchasers to test the truth of our statements before purchasing engines, instead of having to take statements and engines on faith.

Electrical.... Patents.

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED JANUARY 26, 1897.

574,707 Automatic telephone exchange system; Lawrence G. Bowman, Fort Wayne, Ind.—An automatic telephone exchange system comprising means, directly under the control of the subscriber, for connecting his transmitter to that of any other subscriber in a system without the aid of a central operator.

575,699 Electro-mechanical movement; E. D. Chaplin, Cambridge, Mass.—An electro-field magnet, an armature wholly exterior to the coils thereof and reciprocable in its field, and intersecting the lines of force thereof, means to produce a current in the armature, and a device for reversing the direction of the current at each stroke.

575,724 Gearing for electrical motors; A. C. Mather, Chicago, Ill.—A car truck bearing for connecting the car body to the truck, said bearing encircling an electric motor, said motor mounted with its armature shaft horizontal, pinions on the shaft of said motor, sprocket wheels on the axle of the truck, a link chain, two tooth tighteners and springs, one on each side of the armature shaft.

575,772 Roentgen-ray tube; Elihu Thomson, Swampscott, Mass.—An apparatus for the generation of Roentgen rays, comprising a chamber having a Crookes vacuum and provided with a pair of concave electrodes, both of which face upon a bombarded metal piece situated in the focus of their concavities.

575,777 Electric Meter; W. C. Fish, Lynn, Mass.—The combination of an armature, a field-coil therefor, recording mechanism actuated by the armature, and means for weakening the field periodically or at intervals.

575,785 Closed-conduit electric railway; E. W. Rice, Jr., Schenectady, N. Y.—A surface-contact or closed-conduit electric railway system, an independent ground connection adjacent to the pick-up magnet contacts and adapted to protect the coils on the pick-up magnets from extraneous or leakage currents.

575,788 Electric smelting; T. L. Willson, New York.

575,805 Electrical signal system; P. Freeman, New York.

575,826 Electric furnace; J. A. Deuther, Boston, Mass.—A suspended electrode, a mechanism for vibrating said electrode and a feed mechanism for feeding the material to be treated within the path of the electric arc during the interval between a back and-forth movement of said electrode.

575,829 Electric furnace; J. Joyce, Andover, Mass.—An upper electrode, a lower electrode, mechanism for moving said lower electrode from its normal position to expose the same to receive the material to be treated, and a feed mechanism operated by the said movement of said lower electrode for feeding the material to be treated onto said lower electrode.

575,869 Telephone transmitter; R. S. Barnum, Chicago, Ill.

575,883 Electric controlling apparatus for pneumatic dispatch tubes; E. A. Fordyce, Chicago, Ill.

575,887 Microphone; P. Hardegen, Berlin, Germany.

575,896 Telephonic transmitter; Maxymilian Kotyra, London, Eng.—A granular telephone transmitter comprising a vibratory helical case, carbon blocks at each end of the case, and granular microphonic material beween the blocks.

575,908 Switch and signal apparatus; J. G. Schreuder, Edgewood Park, Ill. A series of electrically controlled motors for operating a series of switches and signals or other appliances connected with a track, a series of make-and-break mechanisms controlling the circuits leading to the motors, and mechanical interlocking mechanisms arranged to interlock the switch and signal make-and-break mechanism.

575,918 Brush-carrier for dynamo-electric machines; S. S. Wheeler, New York.—Consists of rings insulated from each other and mounted on the frame of the machine at the inner end of the commutator, brush-carriers on the rings extending over the commutator, and brushes mounted on the carriers.

575,952 Insulator; F. Hoover, Paducah, Ky.

576,053 Electric appliance for horses; L. A. Gray, Arlington, Md.—Consists of means for inducing an electric current in a metal piece connected to the girth under the belly of the horse.

The Effect of Personal Mention.

The ELECTRICAL REVIEW had occasion to recently give honorable mention of one of its subscribers, and the result is depicted below and described in his own language, as follows:

"In accordance with my weekly custom I sought a secluded corner in my club with the last issue of the ELECTRICAL REVIEW, to digest, leisurely, the electrical news of the week. Much to my surprise

and astonishment I find myself famous—my praises sung to the tune of a full column by no less a poet than the editor. I can only seek recourse to pen and pencil to express the highly ecstatic state of mind I find myself in at present."

It will be observed from the above illustration that our happy subscriber began with a syphon of seltzer, and as he progressed in his perusal of the article his head developed, his cigar was exchanged for a locomotive perfecto and his liquid refreshment changed to a small bottle, aye, two, of champagne. "Before" and "after" reading are strikingly pictured.

The Way To Fill Orders Satisfactorily.

The Central Electric Company, of Chicago, secured an order for transformers, aggregating 9,000 lights capacity, on the evening of January 13, delivering the same day from their Chicago stock 2,000 lights capacity, and placing with the Wagner Electric Manufacturing Company, for whom they are general western agents, the balance of the order of 7,000 lights, via long-distance telephone, communicating direct from their office with the Wagner company. By 10 o'clock on the morning of the following day the goods were loaded into a special car, reaching Chicago the following morning, and being installed complete at the Coliseum by Mr. D. Avery Kimbark, electrical engineer for the National Board of Trade of Cycle Manufacturers, on the 16th. From point of promptness this shipment is without question a "record breaker," not only with reference to the shipment, but also regarding the manner in which the installation was made by Mr. Kimbark after the goods were turned over to him.

The Central Electric Company states that it has "more transformers and general supplies," which it can furnish in the same prompt manner, and that its friends need not be overmodest about calling upon it, and that it will not be necessary to note on the bottom of orders, "Get a move on."

A Good Air-Brake.

Mr. Geo. E. Pratt, general manager of the Hunt Air-Brake Company, informs the ELECTRICAL REVIEW that several of his company's brakes are in successful operation on various electric railway lines in Pittsburgh. The automatic electric controlling switch used in connection with these brakes is of a very simple, and at the same time effective, design.

A NOTICE.

It having come to our notice on several occasions recently that some of our competitors in the manufacture of water-tube boilers have been offering to the general public Babcock & Wilcox type of boilers, the headers, or manifolds, and cross-boxes on which are claimed to be made of "flowed" steel, we desire to call your attention to the fact that "flowed" steel is a special mix of open-hearth steel manufactured under a secret formula which belongs to us alone, the knowledge of the preparation of which is in the possession of no one except the Penn Steel Casting and Machine Company, of Chester, Pa., and as any one offering either headers, cross-boxes or flanges made of "flowed" steel is doing so with intent to deceive the public, we wish that you would publish for us in your paper the foregoing statement, and in addition the accompanying letter written to the Penn Steel Casting and Machine Company by our general eastern agents, and their answer to the same.

CAHALL SALES DEPARTMENT.

Pittsburgh, January 22.

OFFICE OF THAYER & COMPANY, INCORPORATED, DREXEL BUILDING, PHILADELPHIA, January 21, 1897.

PENN STEEL CASTING AND MACHINE COMPANY, CHESTER, PA.

GENTLEMEN: We have information that certain parties are claiming to be able to furnish, in fact, offer to furnish, with their boilers, headers and other parts of "flowed" steel.

As "flowed" steel is of a special mixture and our property, we would ask if you have ever furnished, or are you now furnishing, "flowed" steel headers to any party or parties other than ourselves?

An early reply will oblige,

Yours truly,

(Signed) THAYER & COMPANY, INCORPORATED.

OFFICE OF PENN STEEL CASTING AND MACHINE COMPANY, CHESTER, PA., January 21, 1897.

MESSRS. THAYER & COMPANY, INCORPORATED, DREXEL BUILDING, PHILADELPHIA.

GENTLEMEN: Referring to your inquiry of even date, we beg to state that we consider the special mixture for flowed steel we are making for you your property, of which you have the sole right, and that we never have nor never will furnish flowed steel to any one but yourselves unless authorized by you. Neither will we give to any one any information as to the formula under which this special mixture is made.

Yours respectfully,

PENN STEEL CASTING AND MACHINE COMPANY,

(Signed) FRED BALDT, Manager.

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Thomas A. Edison

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Solicitor of Patents. WASHINGTON, D. C.

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